This document was too large to scan as a single document. It has been divided into smaller sections.

Section 2 OF 2

Document Information			
Document #	0500541		
Title	DRAFT INTEGRATED DISPOSAL FACILITY (IDF) DANGEROUS WASTE PERMIT		
DATE	05/04/2005		
Originator	M. A. WILSON	**Originator Co.**	DOEC
Recipient	KA KLEIN, RJ SCHEPENS, ES AROMI	**Recipient Co.**	DOE-RL, DOE-ORP, CH2M
References			
Keywords			
Projects			
Other Information			

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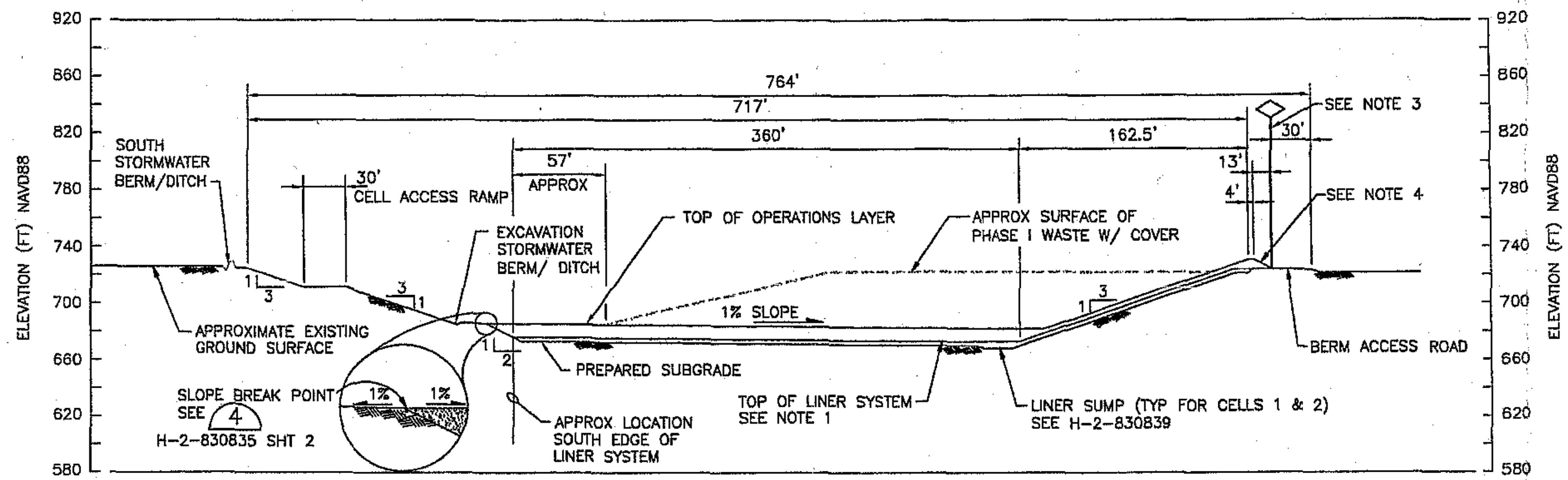
the Nuclear Waste Program
Resource Center
3100 Port of Benton
Richland, Washington.

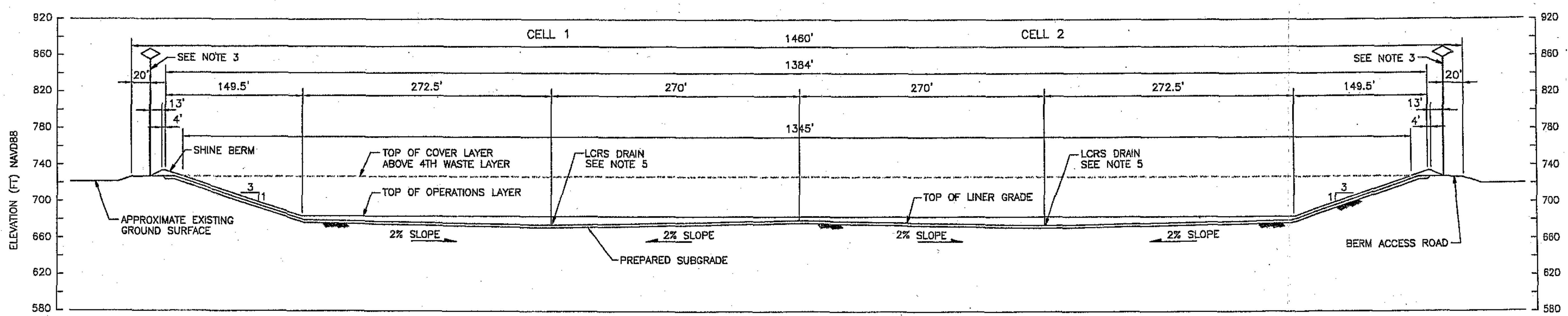
Please contact Valarie Peery at
(509) 372-7920
for a viewing appointment.

NOTES:

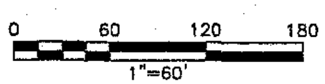
1. FOR LINER SYSTEM, SEE H-2-830836 AND H-2-830838.
2. FOR SUBGRADE LAYER AND OPERATIONS LAYER DETAILED SECTIONS, SEE H-2-830833 AND H-2-830834.
3. SURVEY CONTROL LINE, SEE H-2-830829, H-2-830833 AND H-2-830834.
4. CREST PAD BLDG NOT SHOWN. SEE H-2-830846 FOR DETAILS.
5. SEE H-2-830845 FOR LCRS PIPING PLAN.



SECTION A
1" = 60' H-2-830830



SECTION B
1" = 60' H-2-830830



BLDG. NO.

INDEX NO.

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

JOHN N. WINTERS
STATE OF WASHINGTON
30601
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 04/04/04

CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
GRADING AND DRAINAGE
SECTIONS

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	200E	0111	H-2-830832	A

SCALE 1"=60' | CDT 634144 | SHEET 1 OF 1

NAME | DATE | COMPANY
DRAWN BY G ALMSTROM | 2/4/04 | CH2MHILL
DSGN APPROVED J WINTERS | 2/4/04 | CH2MHILL
DESIGN AUTHORITY E CHOHO

DWG NO | TITLE | DRAWING TRACEABILITY LIST

REF NUMBER | TITLE | REFERENCES | NEXT USED ON

REV NO | DESCRIPTION | REV BY DATE | ENGR | COMPANY | REVISIONS

XXXX PLOTID XXXX

8 7 6 5 4 3 2 1

A B C D

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Richland, Washington.

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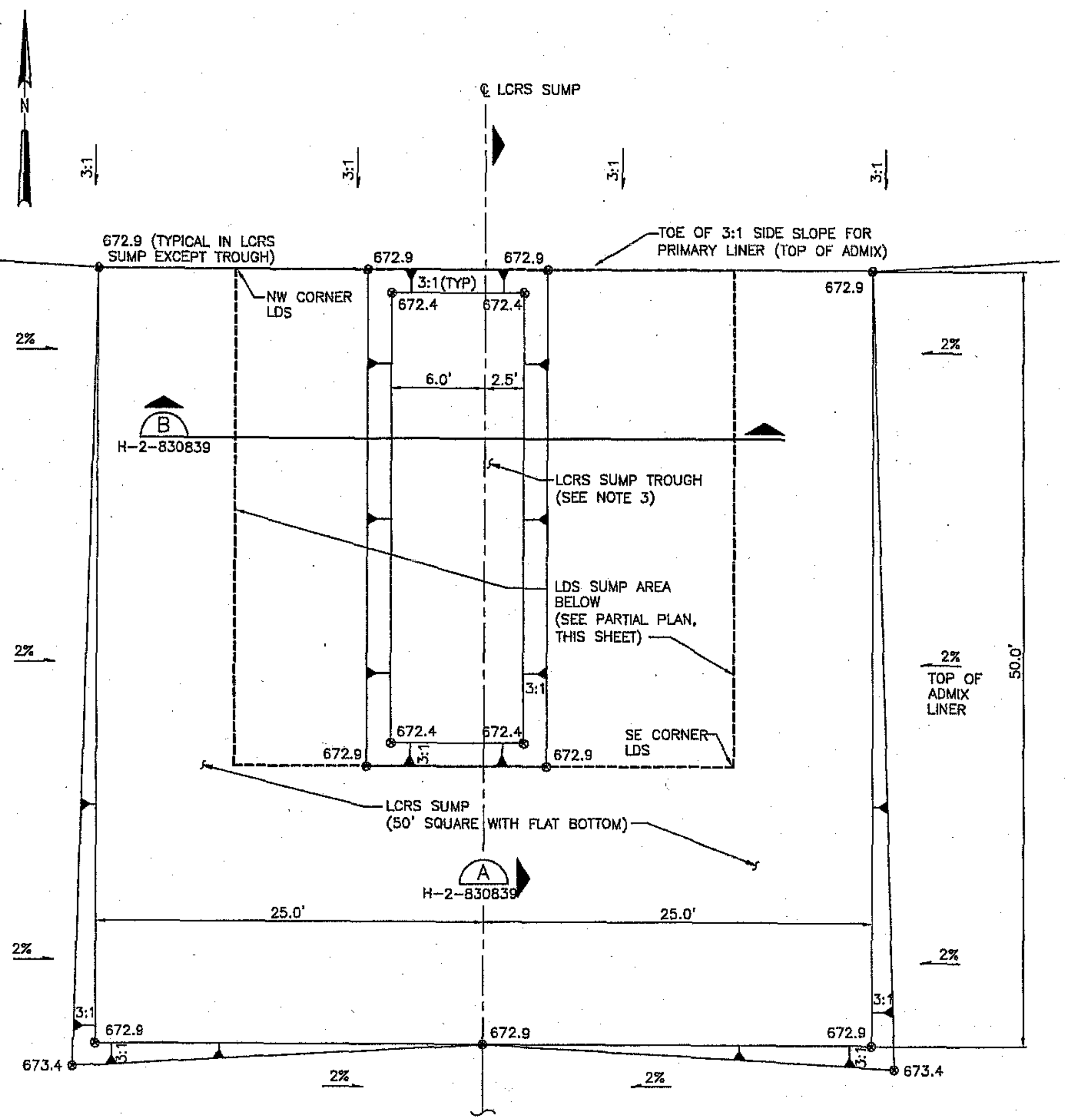
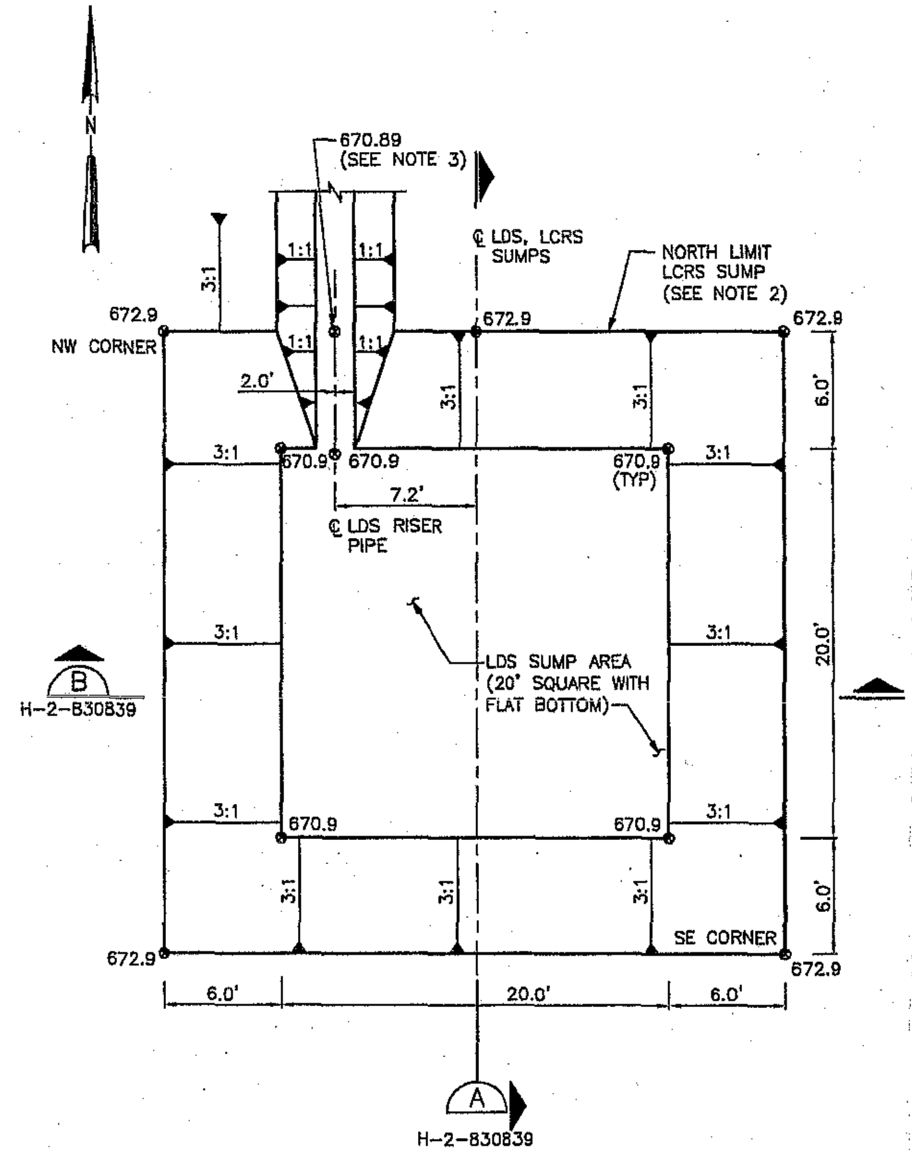
for a viewing appointment.



LCRS SUMP PARTIAL PLAN
1" = 5'-0" H-2-830836



LDS SUMP PARTIAL PLAN
1" = 5'-0"

LCRS SUMP PARTIAL PLAN NOTES:

1. GRADES SHOWN ARE TOP OF ADMIX LINER EXCEPT WITHIN LCRS SUMP TROUGH AND LDS SUMP AREAS. WITHIN LCRS SUMP TROUGH AND LDS SUMP AREAS GRADES SHOWN ARE TOP OF PRIMARY GEOMEMBRANE. SEE LDS SUMP PARTIAL PLAN FOR TOP OF ADMIX GRADES IN THIS AREA.
2. FOR SUBGRADE CONTROL LINE BELOW LCRS SUMP, SEE DETAILS 1 AND 2 ON DWG. H-2-830829, SHEET 1 OR 2.
3. SEE SPECIFICATION SECTION 02661 FOR GEOMEMBRANE PANEL LAYOUT REQUIREMENTS FOR LCRS SUMP TROUGH.

LDS SUMP PARTIAL PLAN NOTES:

1. GRADES SHOWN ARE TOP OF ADMIX LINER.
2. PRIMARY AND SECONDARY GEOMEMBRANE GRADES MATCH AT EL 672.89 (TYP ALL SIDES OF LDS SUMP). CONTINUE 3:1 SLOPE TO ANCHOR TRENCH AT PERIMETER DIKE.
3. START 3:1 SLOPE AT TRENCH BOTTOM. BEGIN TRANSITION TO MAINTAIN 2'-0" DEPTH BELOW PRIMARY LINER GRADES SHOWN ON H-2-830836
4. FOR SUBGRADE CONTROL LINES BELOW LDS SUMP, SEE DETAILS 1 AND 2 ON DWG. H-2-830829, SHEET 1 OR 2.

BLDG. NO. 200E

INDEX NO. 0111

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

MICHAEL W. REIMBOLD, STATE OF WASHINGTON, 28614, REGISTERED PROFESSIONAL ENGINEER, EXPIRES 12/24/04

CH2MHILL

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

REVISIONS

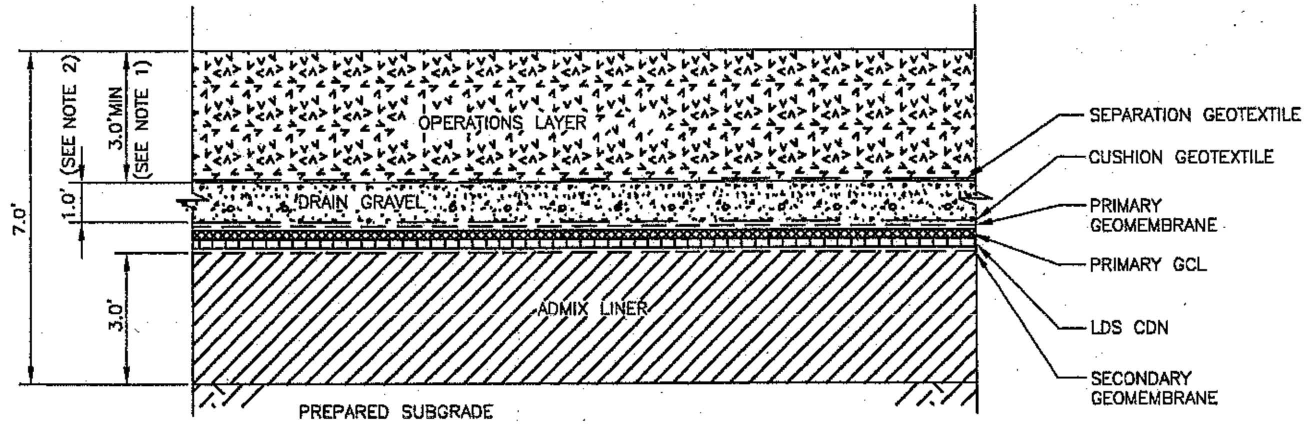
NAME	DATE
DRAWN BY R LATTA	2/6/04
DFTG APPROVED M. REIMBOLD	2/6/04
DESIGN AUTHORITY E. GRIGGS	2/17/04

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
CELLS 1 AND 2
SUMP PARTIAL PLANS

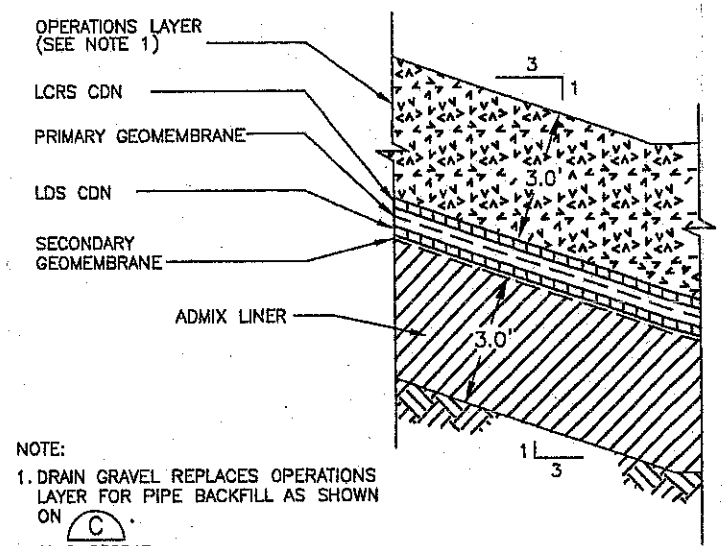
SIZE D | BLDG NO 200E | INDEX NO 0111 | DWG NO H-2-830837 | REV A
SCALE 1" = 100' | 634144 | SHEET 1 OF 1

XXXX PLOTID XXXX



NOTES:
1. OPERATIONS LAYER THICKNESS VARIES ACROSS CELL BOTTOM WITH A 3-FOOT MIN. THICKNESS.
2. INCREASE DRAIN GRAVEL THICKNESS IN VICINITY OF LEACHATE COLLECTION AND RISER PIPES IN LCRS SUMP AS SHOWN ON B H-2-830848 AND D H-2-830845

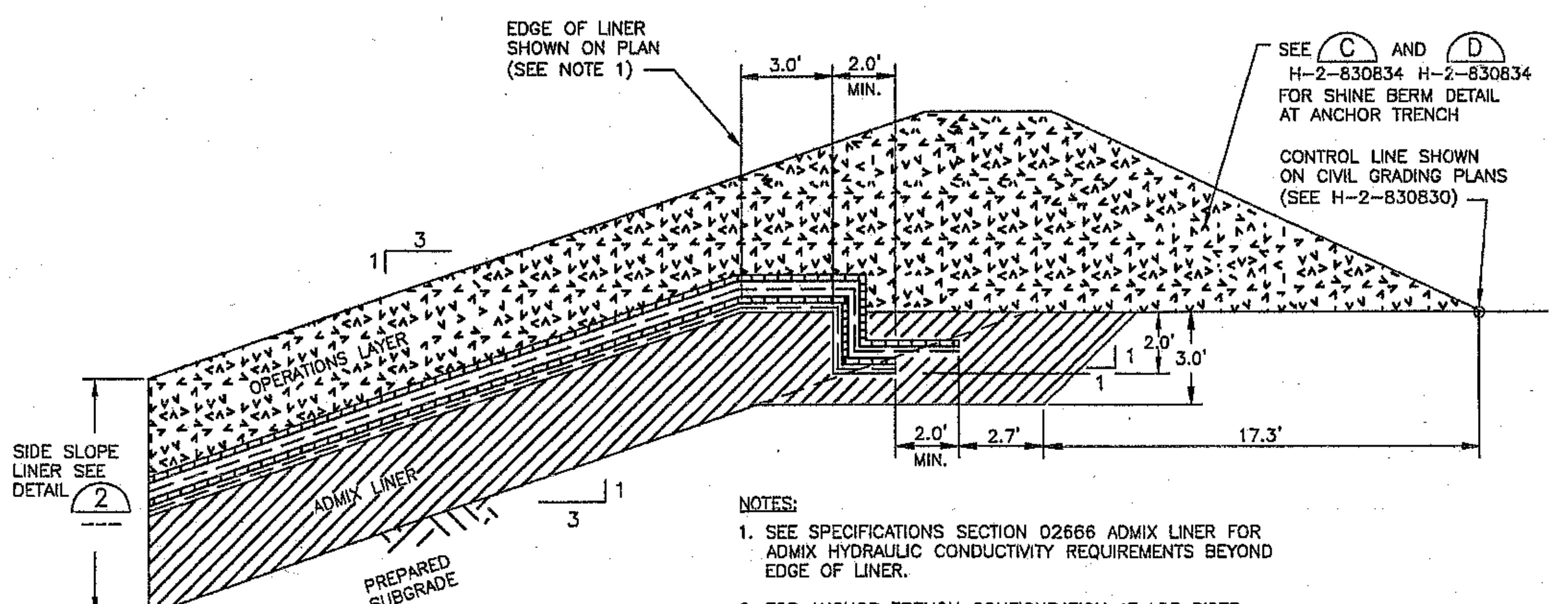
BOTTOM LINER DETAIL 1
NTS
H-2-830836, H-2-830839
H-2-830840, H-2-830848, H-2-830845



NOTE:
1. DRAIN GRAVEL REPLACES OPERATIONS LAYER FOR PIPE BACKFILL AS SHOWN ON C H-2-830848

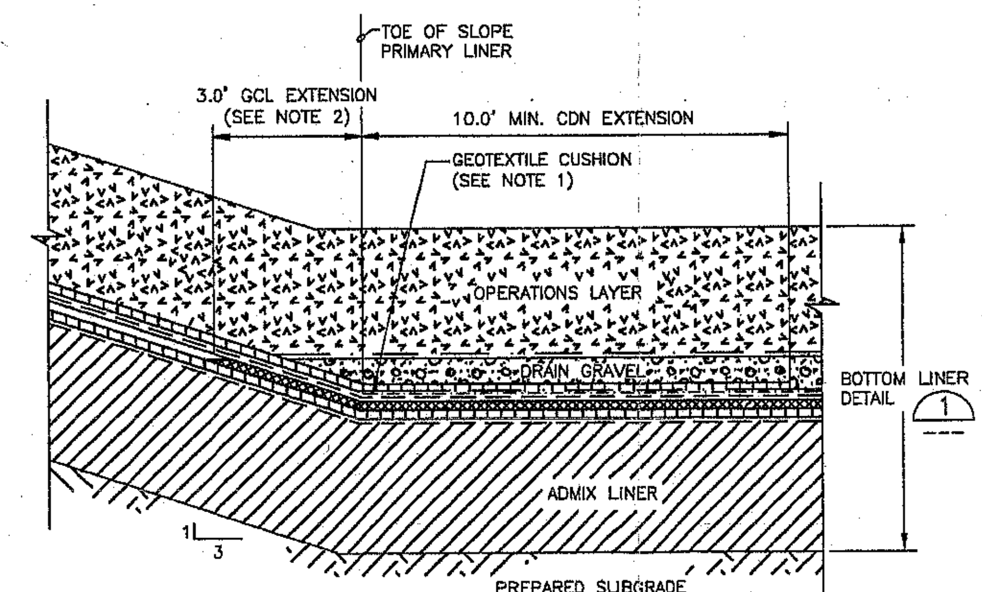
SIDE SLOPE LINER DETAIL 2
NTS
H-2-830836, H-2-830839,
H-2-830840, H-2-830848, H-2-830849

GENERAL NOTE (H-2-830838 THROUGH 830840)
SPACING BETWEEN GEOSYNTHETIC LAYERS IS EXAGGERATED FOR CLARITY.



NOTES:
1. SEE SPECIFICATIONS SECTION 02666 ADMIX LINER FOR ADMIX HYDRAULIC CONDUCTIVITY REQUIREMENTS BEYOND EDGE OF LINER.
2. FOR ANCHOR TRENCH CONFIGURATION AT LDS RISER PIPE TRENCH SEE SECTION C ON DWG. H-2-830847.

LINER ANCHOR TRENCH DETAIL 3
NTS
H-2-830834, H-2-830836



NOTES:
1. GEOTEXTILE CUSHION ENDS AT TOE OF SLOPE
2. EXTEND GCL 3.0' UP SLOPE (HORIZONTAL LENGTH) TO TOP OF DRAIN GRAVEL.

TOE OF SLOPE LINER DETAIL 4
NTS
H-2-830836, H-2-830839

BLDG. NO. 200E
INDEX NO. 0111
THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

MICHAEL W. REMBOLD, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 22814
EXPIRES 12/24/04

CH2MHILL

NAME	DATE	COMPANY
DRAWN BY R. LATTA	2/4/04	CH2MHILL
ENG APPROVED M. REMBOLD	2/4/04	CH2MHILL
DESIGN AUTHORITY	2/4/04	CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
GEOSYNTHETICS
SECTIONS AND DETAILS

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	200E	0111	H-2-830838	A

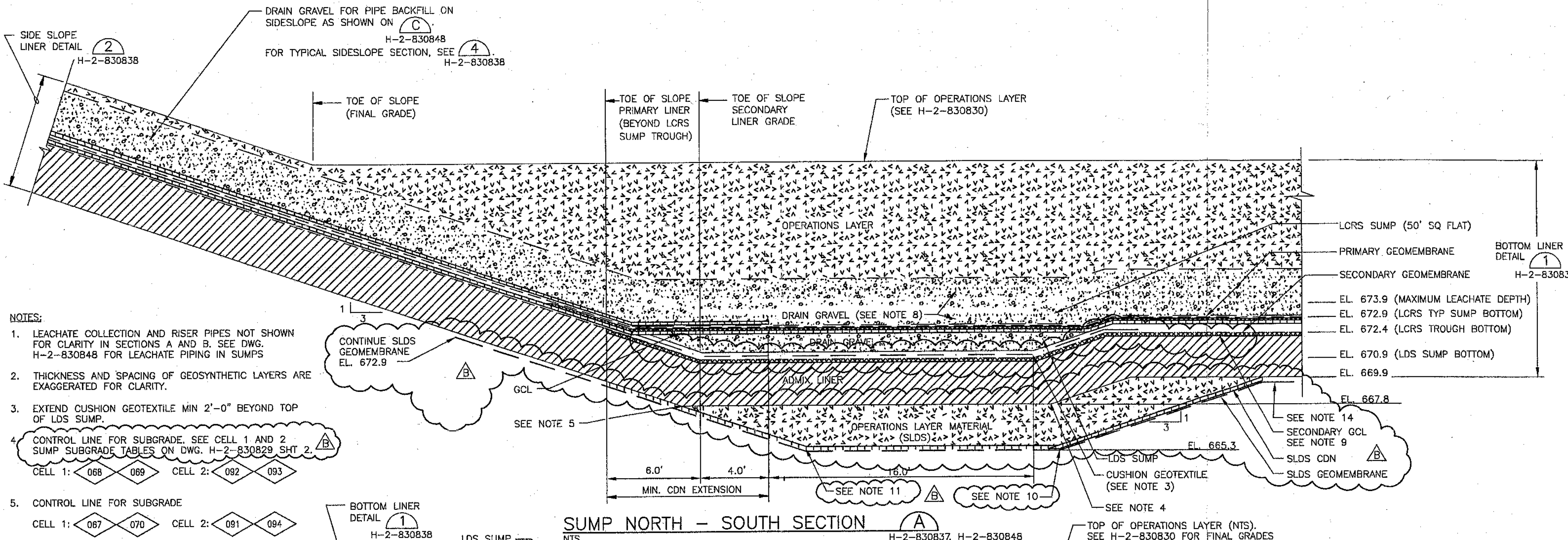
SCALE AS SHOWN | 634144 | SHEET 1 OF 1

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

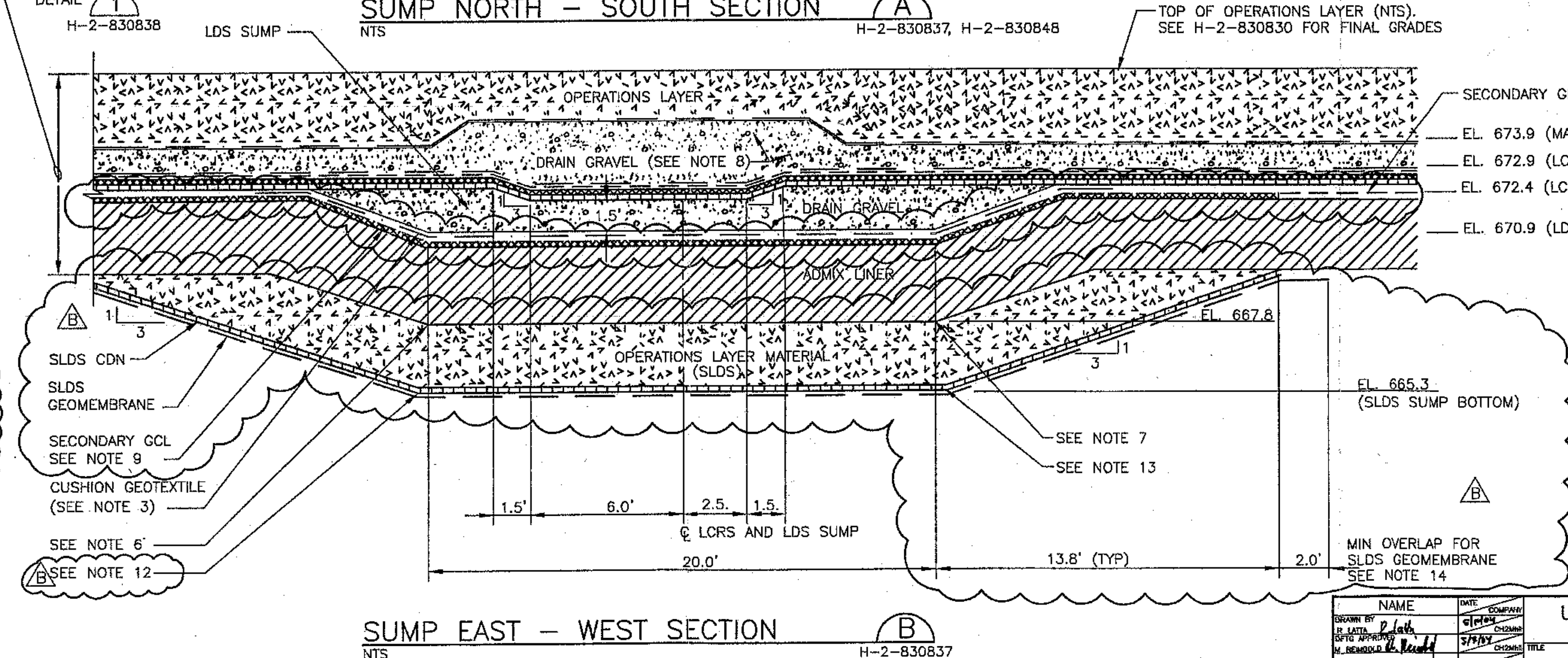
REV NO	DESCRIPTION	REV BY DATE	ENGR	COMPANY
REVISIONS				

XXXX PLOTID XXXX

DWG NO H-2-830839 SH 1 OF 1 REV B



SUMP NORTH – SOUTH SECTION A
NTS
H-2-830837, H-2-830848



SUMP EAST – WEST SECTION B
NTS
H-2-830837

NOTES:

1. LEACHATE COLLECTION AND RISER PIPES NOT SHOWN FOR CLARITY IN SECTIONS A AND B. SEE DWG. H-2-830848 FOR LEACHATE PIPING IN SUMPS
2. THICKNESS AND SPACING OF GEOSYNTHETIC LAYERS ARE EXAGGERATED FOR CLARITY.
3. EXTEND CUSHION GEOTEXTILE MIN 2'-0" BEYOND TOP OF LDS SUMP.
4. CONTROL LINE FOR SUBGRADE. SEE CELL 1 AND 2 SUMP SUBGRADE TABLES ON DWG. H-2-830829 SHT 2.
   CELL 1: 068 069 CELL 2: 092 093
5. CONTROL LINE FOR SUBGRADE
   CELL 1: 067 070 CELL 2: 091 094
6. CONTROL LINE FOR SUBGRADE
   CELL 1: 067 068 CELL 2: 091 092
7. CONTROL LINE FOR SUBGRADE
   CELL 1: 069 070 CELL 2: 093 094
8. INCREASE GRAVEL THICKNESS IN VICINITY OF LEACHATE COLLECTION AND RISER PIPES IN LCRS SUMP AS SHOWN IN B AND D H-2-830848 H-2-830845
9. PROVIDE GCL BENEATH SECONDARY GEOMEMBRANE WITHIN LIMITS OF SLDS SUMP SHOWN ON DWGS. H-2-830837 AND H-2-830849 SHT 2.
10. CONTROL LINE FOR SLDS SUMP SUBGRADE, SEE DETAILS 1 AND 2 ON DWG. H-2-830829 SHT 1.
    CELL 1: 065 066 CELL 2: 088 089
11. CONTROL LINE FOR SUBGRADE
    CELL 1: 056 072 CELL 2: 080 096
12. CONTROL LINE FOR SUBGRADE
    CELL 1: 056 066 CELL 2: 080 089
13. CONTROL LINE FOR SUBGRADE
    CELL 1: 065 072 CELL 2: 088 096
14. PROVIDE 2'-0" MIN. OVERLAP FOR SLDS GEOMEMBRANE ON EAST, WEST, AND SOUTH SIDE OF SLDS.

BLDG. NO. 200E

INDEX NO. 0111

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MICHAEL W. REIMBOLD, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 28614 5/19/04 EXPIRES 12/24/04

CH2MHILL

DWG NO	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
REFERENCES	
NEXT USED ON	

REV	MFD	DESCRIPTION	REV BY DATE		ENGR COMPANY
B		ADDITION OF SLDS	4/19/04	M REIMBOLD CH2MHILL	
REVISIONS					

	NAME	DATE	COMPANY
DRAWN BY	R LATTA	5/19/04	CH2MHILL
DSGN APPROVAL	M REIMBOLD	5/19/04	CH2MHILL
DESIGN AUTHORITY	E GROSS	5/19/04	CHG

U.S. DEPARTMENT OF ENERGY
Office of River Protection

TITLE: IDF GEOSYNTHETICS SECTIONS AND DETAILS

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	200E	0111	H-2-830839	B

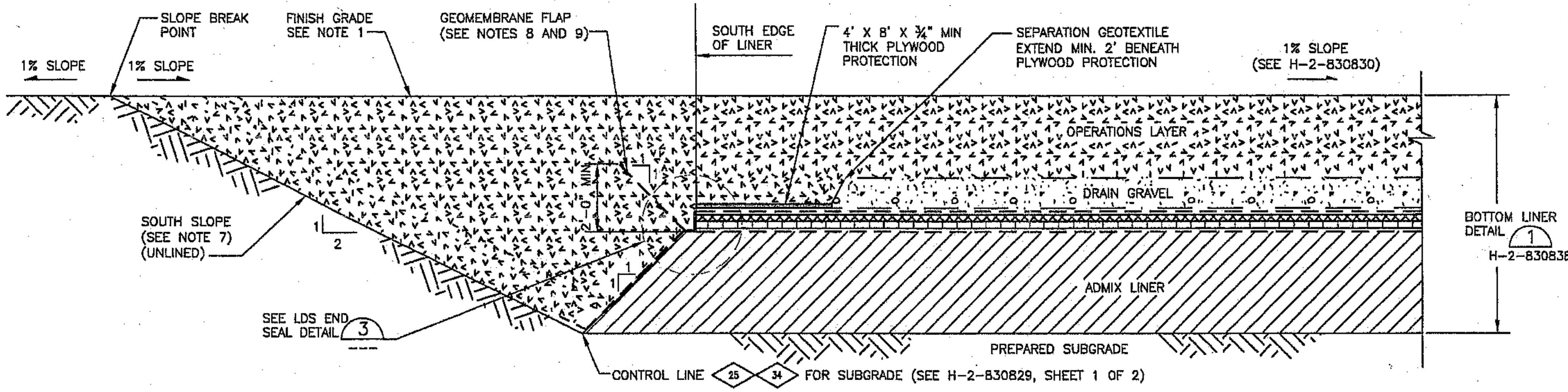
SCALE AS SHOWN | EDT 634144 | SHEET 1 OF 1

XXXX PLOTIN XXXX

DWG NO H-2-830840 SH 1 OF 1 REV A

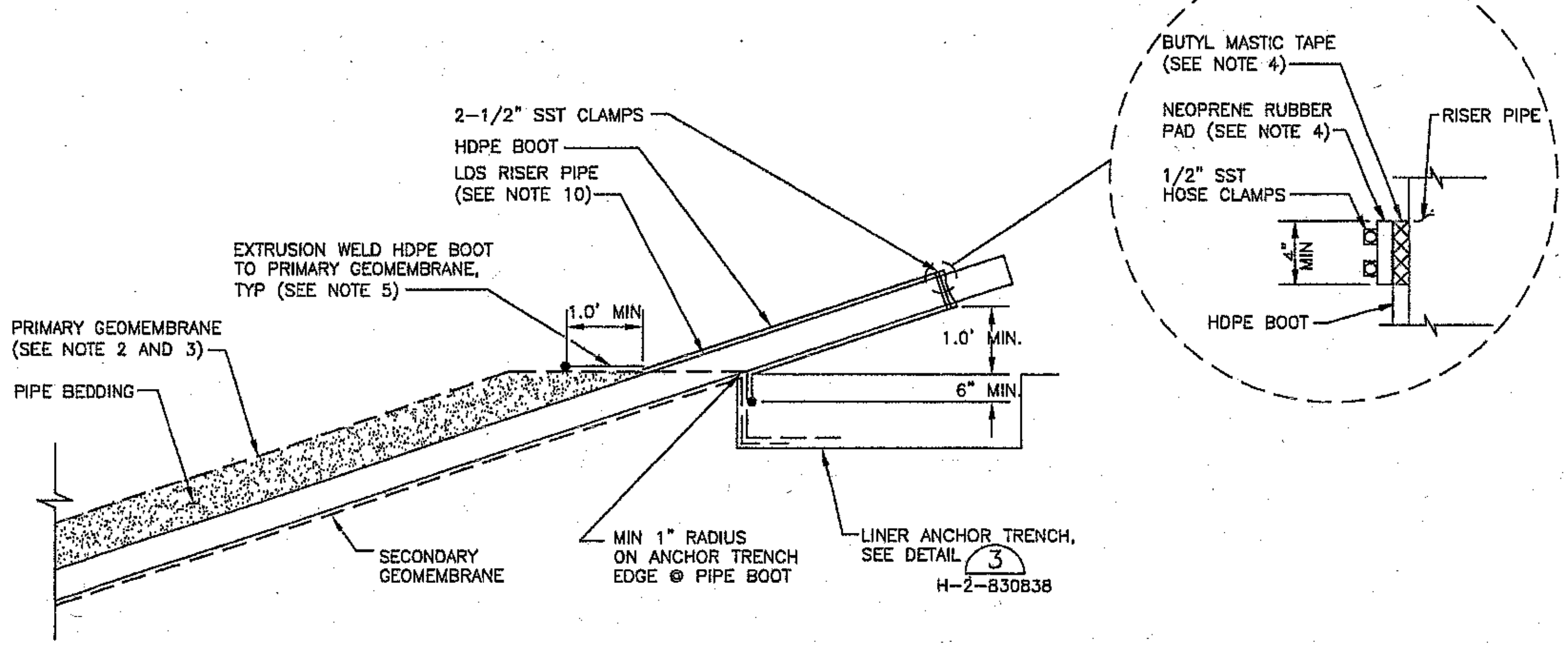
NOTE FOR DETAILS ON H-2-830840:

1. SEE DWG H-2-830830 FOR FINAL GRADING AND DRAINAGE PLAN ABOVE OPERATIONS LAYER AT SOUTH LINER EDGE.
2. OVERLYING LINING SYSTEM COMPONENTS NOT SHOWN FOR CLARITY. SEE SIDE SLOPE LINER DETAIL 3 / H-2-830838
3. ONLY PRIMARY GEOMEMBRANE REQUIRES CONNECTION TO BOOT. FOR OTHER GEOSYNTHETICS, CUT OPENING 1/2" LESS THAN PIPE OD.
4. BUTYL MASTIC TAPE AND NEOPRENE RUBBER PAD APPLIED CONTINUOUSLY AROUND PIPE.
5. FORM BOOT WITH SUFFICIENT MATERIAL TO PREVENT OVERSTRESSING DURING BACKFILLING, BUT WITHOUT FOLDS OR WRINKLES.
6. PROTECT LEADING EDGE OF GEOMEMBRANE AGAINST WIND UPLIFT PRIOR TO PLACEMENT OF OPERATIONS LAYER. CONTRACTOR SHALL SELECT BEST METHOD AVAILABLE SUCH AS SAND BAGS OR TEMPORARY SOIL BERM.
7. CONTRACTOR MAY MODIFY SUBGRADE AT SOUTH SLOPE AS NEEDED FOR GEOSYNTHETICS INSTALLATION ACCESS. BACKFILL TO FINISH GRADE AS SHOWN.
8. PROVIDE GEOMEMBRANE FLAP AS SHOWN ACROSS LANDFILL FLOOR FOR CELL 1 AND 2. EXTEND MINIMUM 6 FEET UP 3:1 SIDE SLOPE FROM TOE OF SLOPE.
9. PROVIDE GEOMEMBRANE PIPE BOOT SIMILAR TO 2 / --- FOR LCRS CLEANOUT IN CELLS 1 AND 2 SHOWN ON H-2-830845.
10. SEE SECTION C ON DWG H-2-830847 FOR LDS RISER PIPE DETAIL.



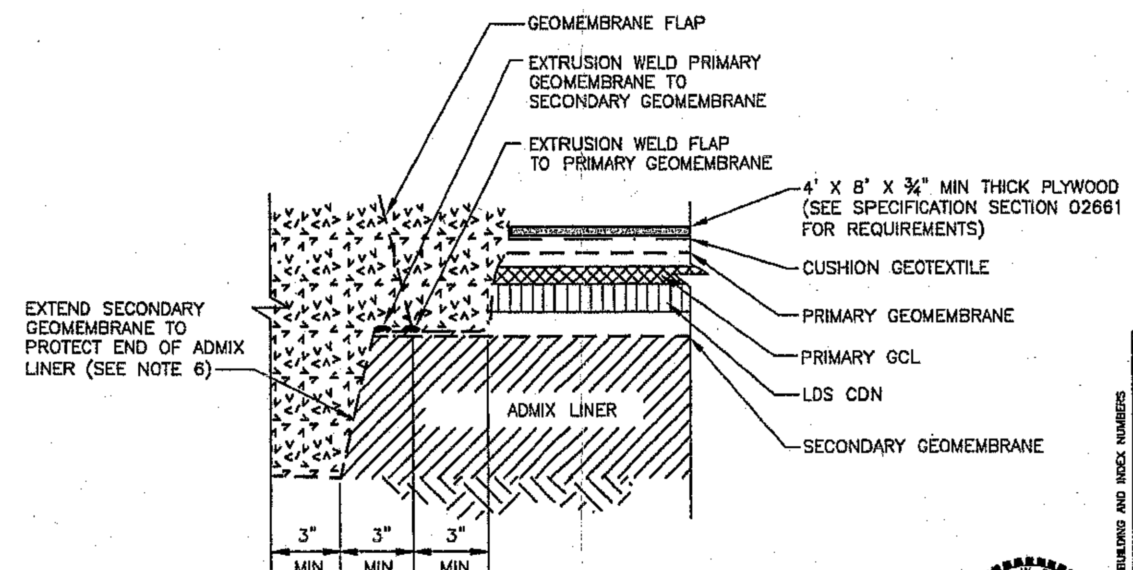
PHASE 1 SOUTH LINER EDGE TERMINATION DETAIL 1 / H-2-830836

NTS



TYPICAL GEOMEMBRANE BOOT DETAIL 2 / H-2-830847, H-2-830849

NTS



LDS END SEAL DETAIL 3 / ---

NTS

BLDG. NO. 200E

INDEX NO. 0111

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

MICHAEL W. REIMBOLD, STATE OF WASHINGTON, 28614 REGISTERED PROFESSIONAL ENGINEER

EXPIRES 12/24/04

CH2MHILL

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

MFD	REV NO	DESCRIPTION	REV BY DATE	ENGR COMPANY
REVISIONS				

	NAME	DATE	COMPANY
DRAWN BY R. LATTA			CH2MHILL
DSGN APPROVED M. REIMBOLD			CH2MHILL
DESIGN AUTHORITY E. GARCIA			CH2MHILL

U.S. DEPARTMENT OF ENERGY

Office of River Protection

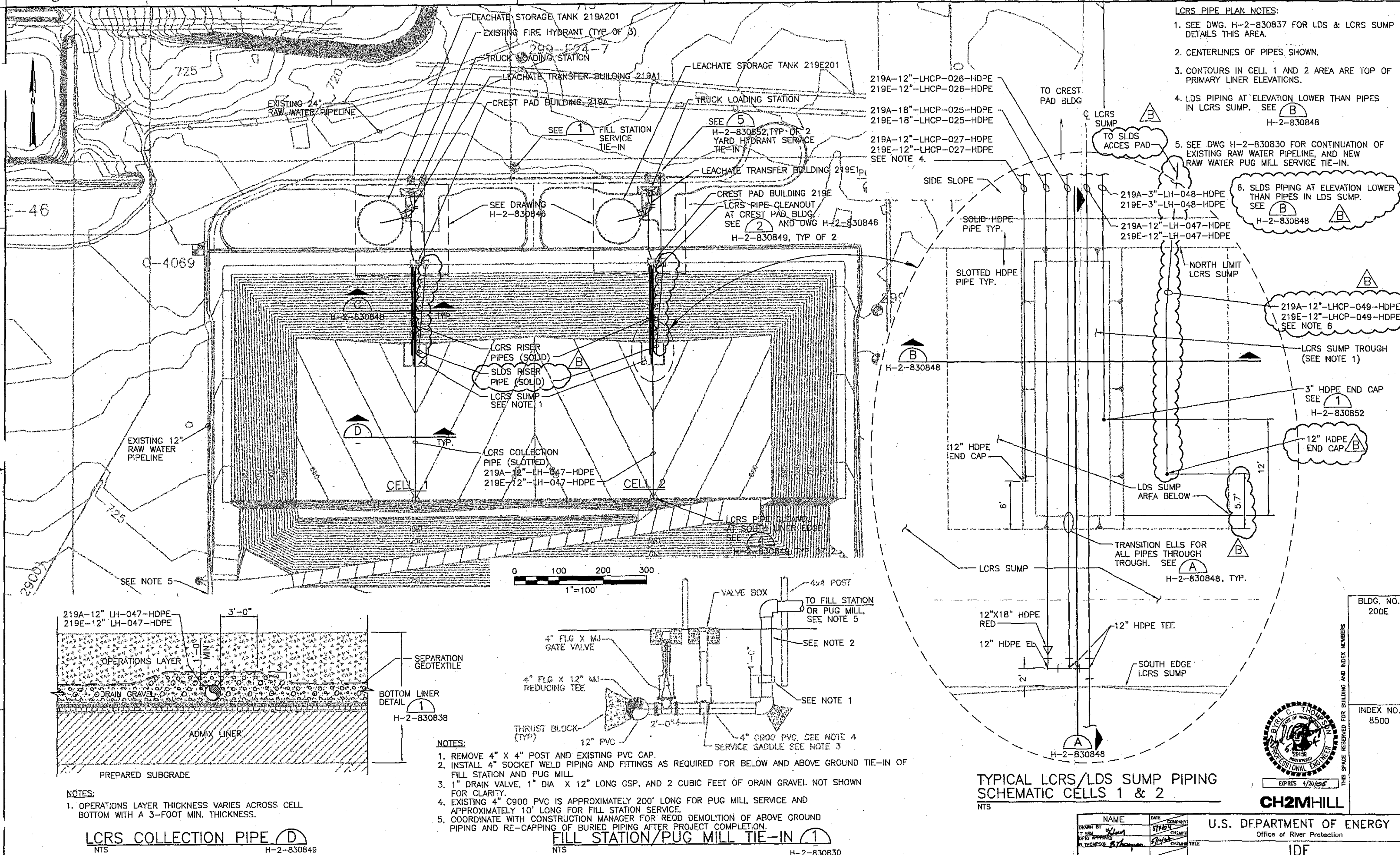
TITLE

IDF GEOSYNTHETICS SECTIONS AND DETAILS

SIZE D | BLDG NO 200E | INDEX NO 0111 | DWG NO H-2-830840 | REV A

SCALE AS SHOWN | EDT 634144 | SHEET 1 OF 1

XXXX PLOTID XXXX



LCRS PIPE PLAN NOTES:

1. SEE DWG. H-2-830837 FOR LDS & LCRS SUMP DETAILS THIS AREA.
2. CENTERLINES OF PIPES SHOWN.
3. CONTOURS IN CELL 1 AND 2 AREA ARE TOP OF PRIMARY LINER ELEVATIONS.
4. LDS PIPING AT ELEVATION LOWER THAN PIPES IN LCRS SUMP. SEE B H-2-830848
5. SEE DWG H-2-830830 FOR CONTINUATION OF EXISTING RAW WATER PIPELINE, AND NEW RAW WATER PUG MILL SERVICE TIE-IN.
6. SLDS PIPING AT ELEVATION LOWER THAN PIPES IN LDS SUMP. SEE B H-2-830848

NOTES:

1. OPERATIONS LAYER THICKNESS VARIES ACROSS CELL BOTTOM WITH A 3-FOOT MIN. THICKNESS.

LCRS COLLECTION PIPE D H-2-830849
NTS

NOTES:

1. REMOVE 4" X 4" POST AND EXISTING PVC CAP.
2. INSTALL 4" SOCKET WELD PIPING AND FITTINGS AS REQUIRED FOR BELOW AND ABOVE GROUND TIE-IN OF FILL STATION AND PUG MILL.
3. 1" DRAIN VALVE, 1" DIA X 12" LONG GSP, AND 2 CUBIC FEET OF DRAIN GRAVEL NOT SHOWN FOR CLARITY.
4. EXISTING 4" C900 PVC IS APPROXIMATELY 200' LONG FOR PUG MILL SERVICE AND APPROXIMATELY 10' LONG FOR FILL STATION SERVICE.
5. COORDINATE WITH CONSTRUCTION MANAGER FOR REQD DEMOLITION OF ABOVE GROUND PIPING AND RE-CAPPING OF BURIED PIPING AFTER PROJECT COMPLETION.

FILL STATION/PUG MILL TIE-IN 1 H-2-830830
NTS

TYPICAL LCRS/LDS SUMP PIPING SCHEMATIC CELLS 1 & 2
NTS

BLDG. NO. 200E

INDEX NO. 8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

EXPIRES 4/20/05

CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
LEACHATE COLLECTION
PIPING PLAN

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	200E	8500	H-2-830845	B

SCALE AS SHOWN — 634144 — SHEET 1 OF 1

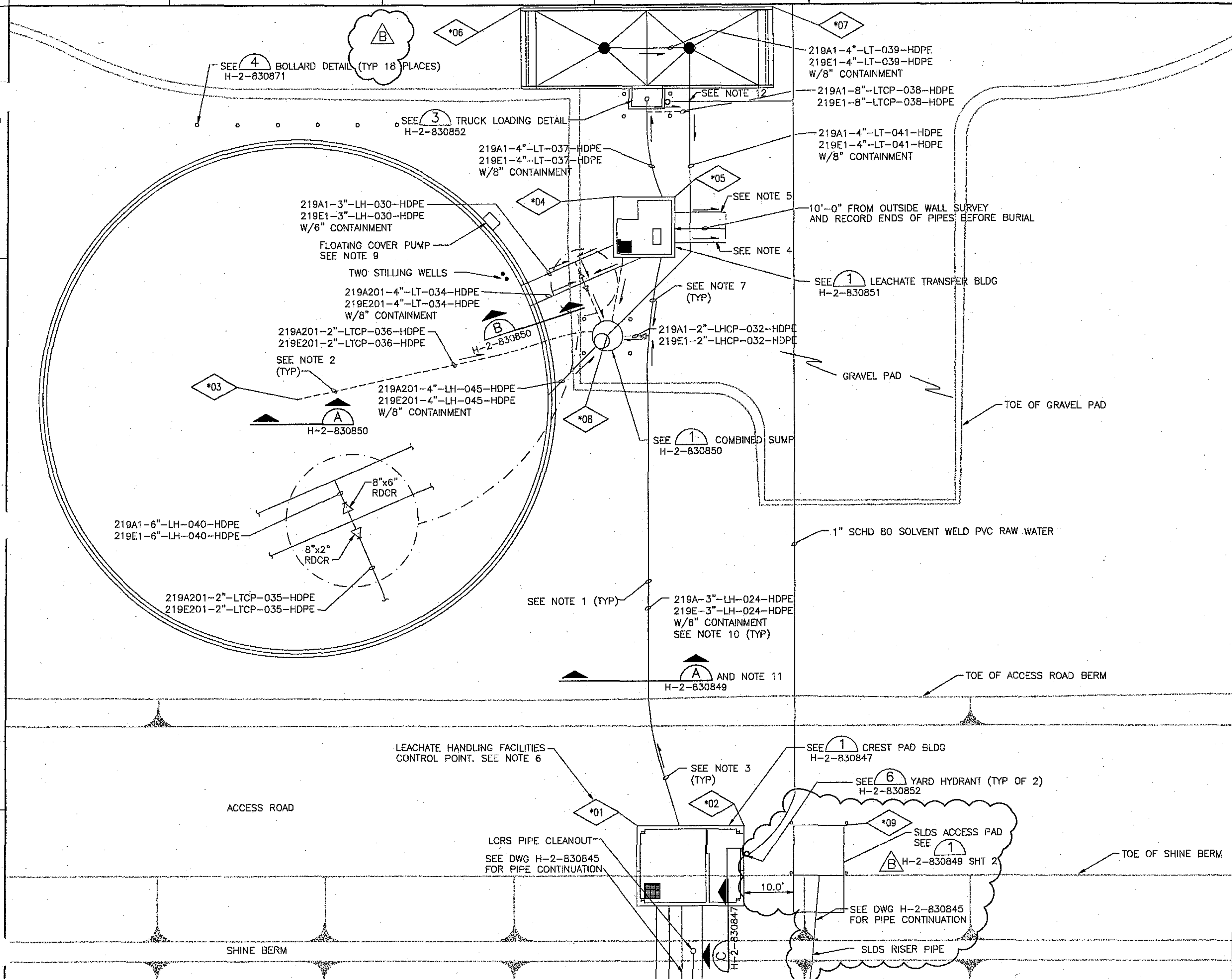
REV	DESCRIPTION	DATE
B	ADDITION OF SLDS	4/23/04

REVISIONS

DWG NO	TITLE	REF NUMBER	TITLE

DRAWING TRACEABILITY LIST — NEXT USED ON — REFERENCES

XXXX PLOTID XXXX



NOTES:

1. PIPES SHOWN AS SOLID LINES NORTH OF CREST PAD BLDG. INDICATE BURIED DOUBLE CONTAINED LEACHATE PIPING OR RAW WATER PIPING.
2. DASHED LINE INDICATES BURIED SINGLE WALL PIPING FOR SECONDARY CONTAINMENT SYSTEMS.
3. SLOPE ALL PIPING IN DIRECTION INDICATED AT 1% SLOPE MINIMUM. FOR PRIMARY PIPE FLOW DIRECTIONS, SEE P&ID'S ON H-2-830854, SHEETS 1 THROUGH 4.
4. INSTALL HDPE CAP ON CARRIER PIPE AND FIXED END SEAL FOR SECONDARY CONTAINMENT PIPE. THIS PIPE IS PROVIDED FOR FUTURE PUMP SUCTION CONNECTION TO FUTURE LEACHATE STORAGE TANK.
5. INSTALL HDPE CAP ON CARRIER PIPE AND FIXED END SEAL FOR SECONDARY CONTAINMENT PIPE. THIS PIPE IS PROVIDED FOR FUTURE LEACHATE TRANSFER BUILDING DISCHARGE CONNECTION TO FUTURE LEACHATE STORAGE TANK.
6. SEE DWG H-2-830829, SHT 2 FOR LEACHATE HANDLING FACILITIES SURVEY CONTROL POINTS. FOR CELL 1 FACILITIES CONTROL POINTS, REPLACE "*" WITH 4; FOR CELL 2 FACILITIES CONTROL POINTS, REPLACE "*" WITH 5.

   EXAMPLE: CELL 2 *02 IS 502
7. BEND RADIUS SHALL NOT BE LESS THAN ALLOWED BY PIPE MANUFACTURER.
8. STILLING WELLS SHALL BE INSTALLED PER TANK MANUFACTURER REQUIREMENTS AT THE LOCATION SHOWN FOR ANALOG AND DISCRETE LEVEL INSTRUMENTATION.
9. FLOATING COVER PUMP AND ASSOCIATED BASEPLATE/BRACKET SHALL BE INSTALLED PER TANK MANUFACTURER REQUIREMENTS AT THE LOCATION SHOWN. THIS PUMP SHALL BE OPERATED AS REQD TO MINIMIZE DEPTH OF RAIN/SNOWMELT ACCUMULATION ON TOP OF FLOATING COVER.
10. PIPING DESIGNATIONS ARE IDENTIFIED FOR CELL 1 AND CELL 2 LEACHATE PIPELINES. THE "219A" PREFIX IS FOR CELL 1 AND THE "219E" PREFIX IS FOR CELL 2.
11. APPLIES TO ALL PIPING NORTH OF CREST PAD BUILDING INCLUDING RAW WATER PIPING EXCEPT RAW WATER PIPIING SHALL HAVE MINIMUM 3'-6" OF COVER.
12. INSTALL 1" RAW WATER PIPE A MINIMUM OF 6" BELOW 8" HDPE PIPE.

N

0 10 20 30
1"=10'

BLDG. NO.
219A
219A1
219A201
219E
219E1
219E201

INDEX NO.
8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

EDWARD JOHN THOMAS
STATE OF WASHINGTON
38507
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 8/4/05
5/10/04

CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
LEACHATE TRANSFER
PIPING PLAN

DRAWN BY	C. BENTZ	5/10/04	CH2MHILL
DFTG APPROVED	E. THOMAS	5/10/04	CH2MHILL
DESIGN AUTHORITY	E. GIRGIS	5/12/04	CHG

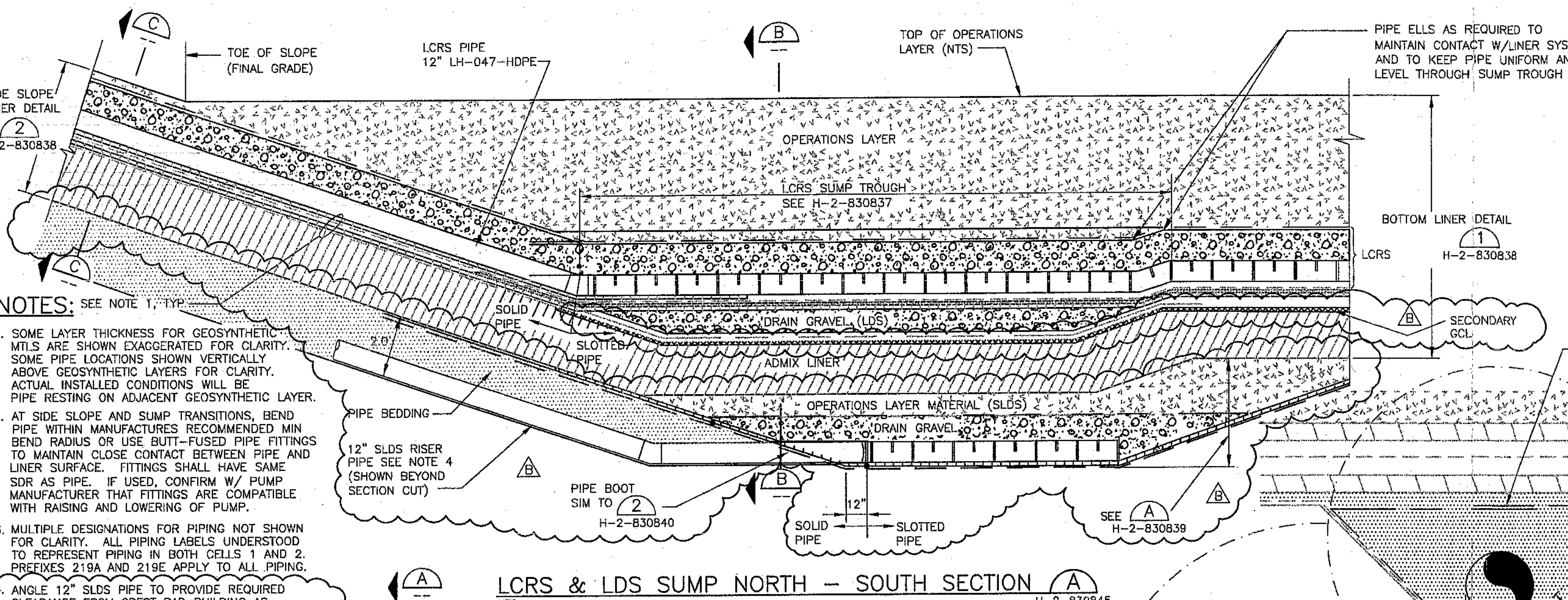
SIZE D | BLDG NO 219A 219A1 | INDEX NO 8500 | DWG NO H-2-830846 | REV B
SCALE AS SHOWN | 634144 | SHEET 1 OF 1

REV	DESCRIPTION	DATE		
B	ADDITION OF SLDS	4/19/04	E THOMAS	CH2MHILL

REVISIONS

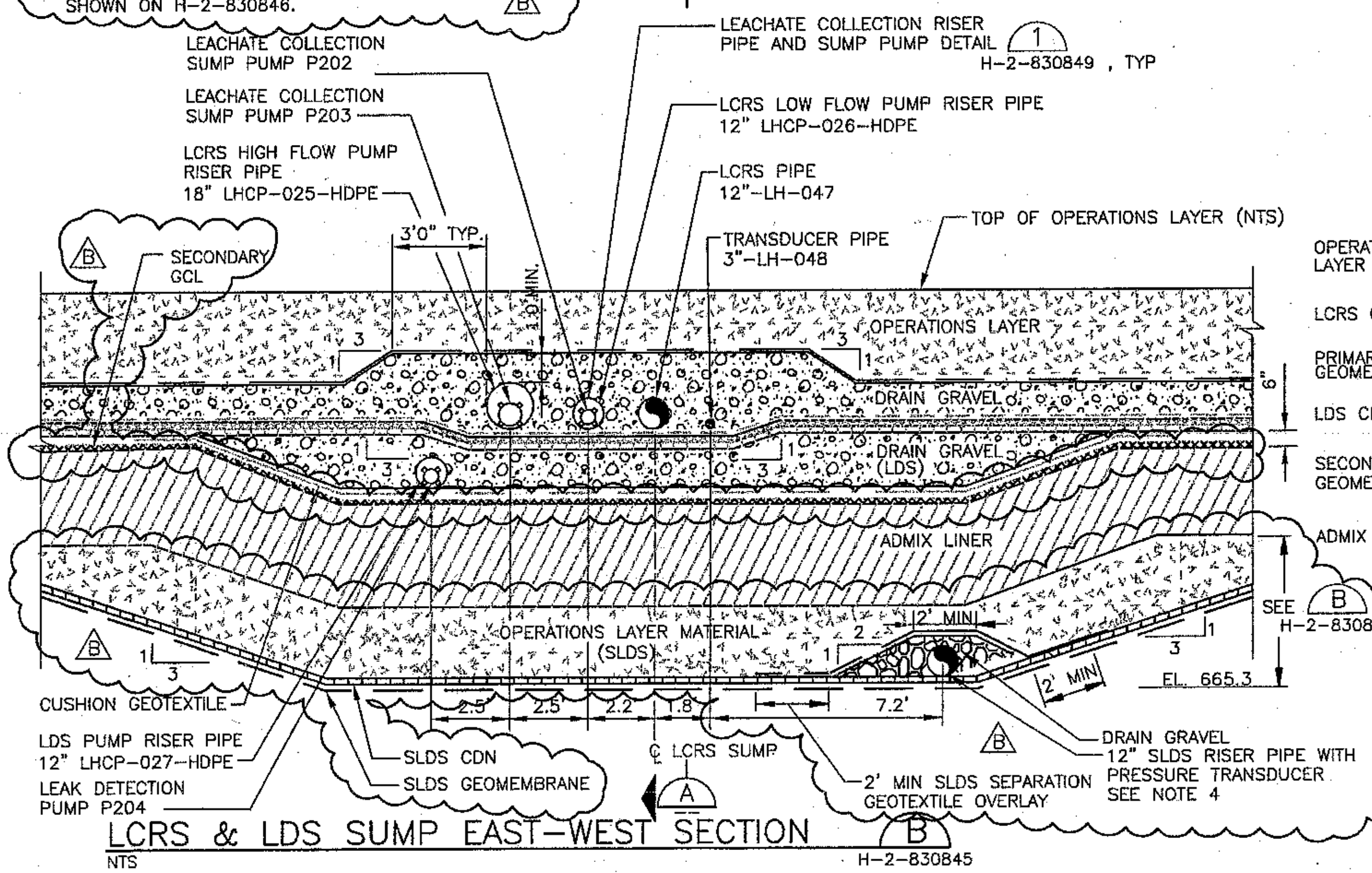
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

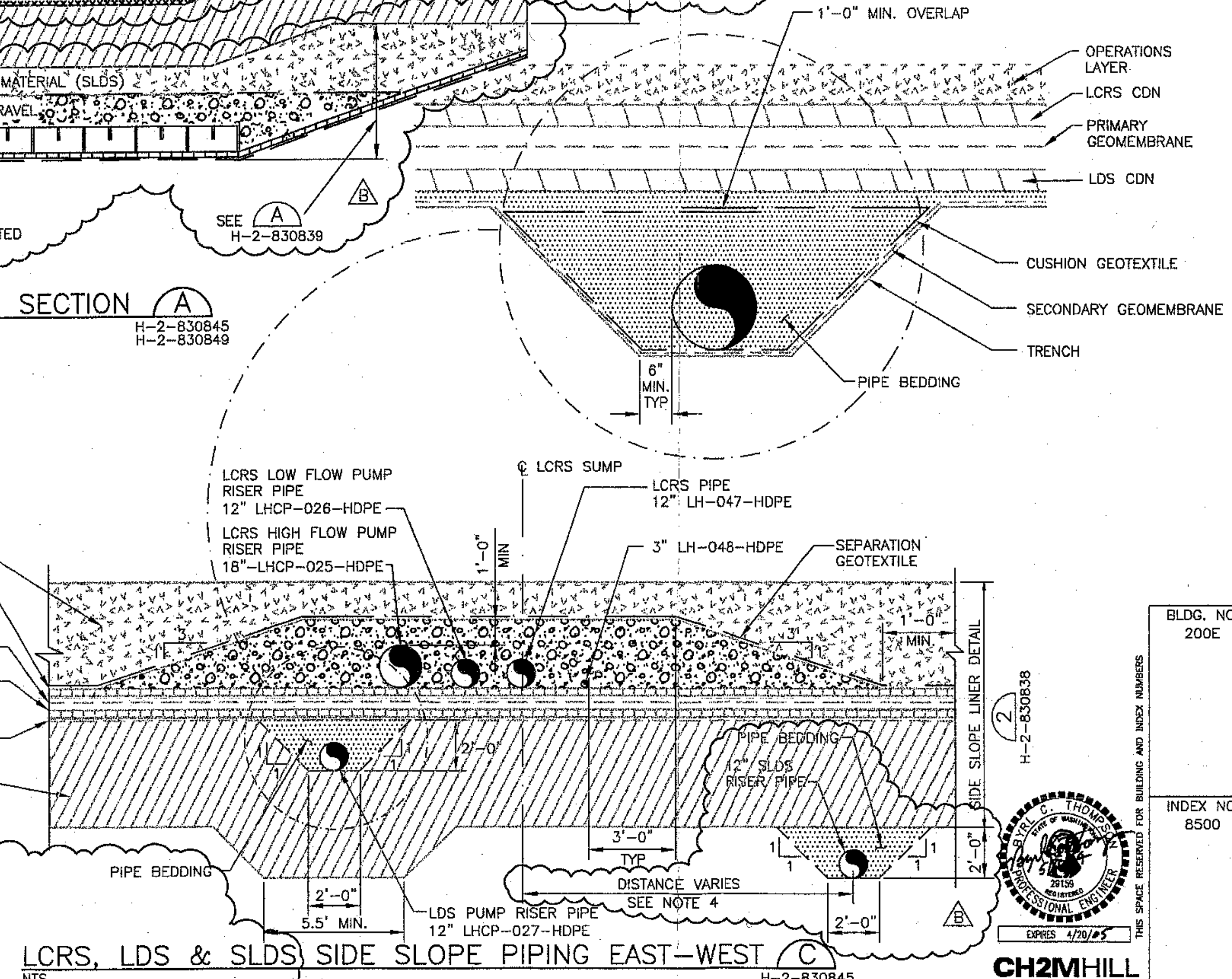
REF NUMBER	TITLE
REFERENCES	
NEXT USED ON	



NOTES:

1. SOME LAYER THICKNESS FOR GEOSYNTHETIC MTLS ARE SHOWN EXAGGERATED FOR CLARITY. SOME PIPE LOCATIONS SHOWN VERTICALLY ABOVE GEOSYNTHETIC LAYERS FOR CLARITY. ACTUAL INSTALLED CONDITIONS WILL BE PIPE RESTING ON ADJACENT GEOSYNTHETIC LAYER.
2. AT SIDE SLOPE AND SUMP TRANSITIONS, BEND PIPE WITHIN MANUFACTURES RECOMMENDED MIN BEND RADIUS OR USE BUTT-FUSED PIPE FITTINGS TO MAINTAIN CLOSE CONTACT BETWEEN PIPE AND LINER SURFACE. FITTINGS SHALL HAVE SAME SDR AS PIPE. IF USED, CONFIRM W/ PUMP MANUFACTURER THAT FITTINGS ARE COMPATIBLE WITH RAISING AND LOWERING OF PUMP.
3. MULTIPLE DESIGNATIONS FOR PIPING NOT SHOWN FOR CLARITY. ALL PIPING LABELS UNDERSTOOD TO REPRESENT PIPING IN BOTH CELLS 1 AND 2. PREFIXES 219A AND 219E APPLY TO ALL PIPING.
4. ANGLE 12" SLDS PIPE TO PROVIDE REQUIRED CLEARANCE FROM CREST PAD BUILDING AS SHOWN ON H-2-830846.





BLDG. NO. 200E

INDEX NO. 8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

CYRIL C. THOMPSON, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 29159, EXPIRES 4/20/05

CH2MHILL

DWG NO	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
REFERENCES	
NEXT USED ON	

REV NO	DESCRIPTION	REV BY DATE	
B	ADDITION OF SLDS	4/19/04	M REMBOLD CH2MHILL
	REVISIONS		

NAME	DATE	COMPANY
DRAWN BY R LATTA	5/10/04	CH2MHILL
DSGN APPROVED B THOMPSON	5/10/04	CH2MHILL
DESIGN AUTHORITY E GIROIS	5/12/04	CHG

U.S. DEPARTMENT OF ENERGY
Office of River Protection

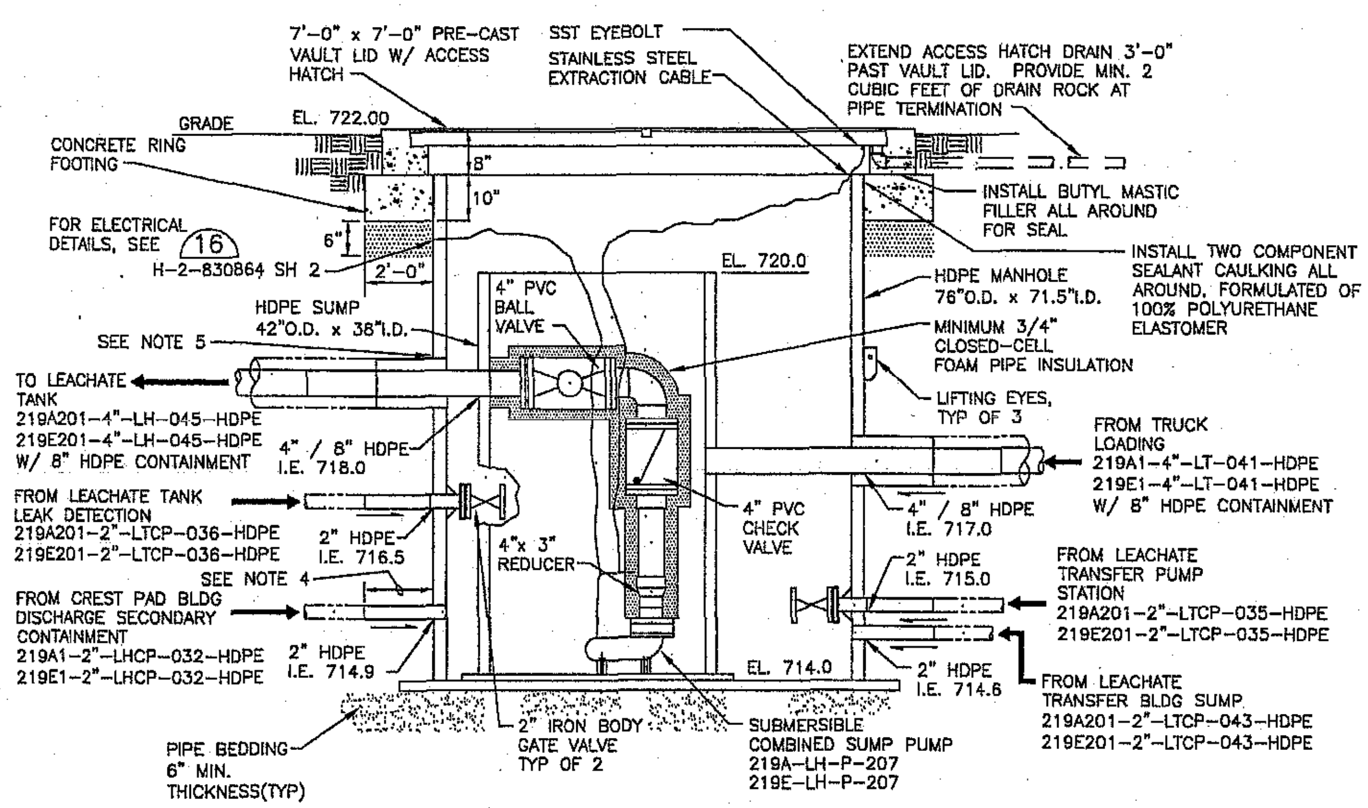
TITLE: IDF LCRS/LDS/SLDS SECTIONS AND DETAILS

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	200E	8500	H-2-830848	B

SCALE AS SHOWN | EDT 634144 | SHEET 1 OF 1

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

DWG NO H-2-830850 SH 1 OF 1 REV A



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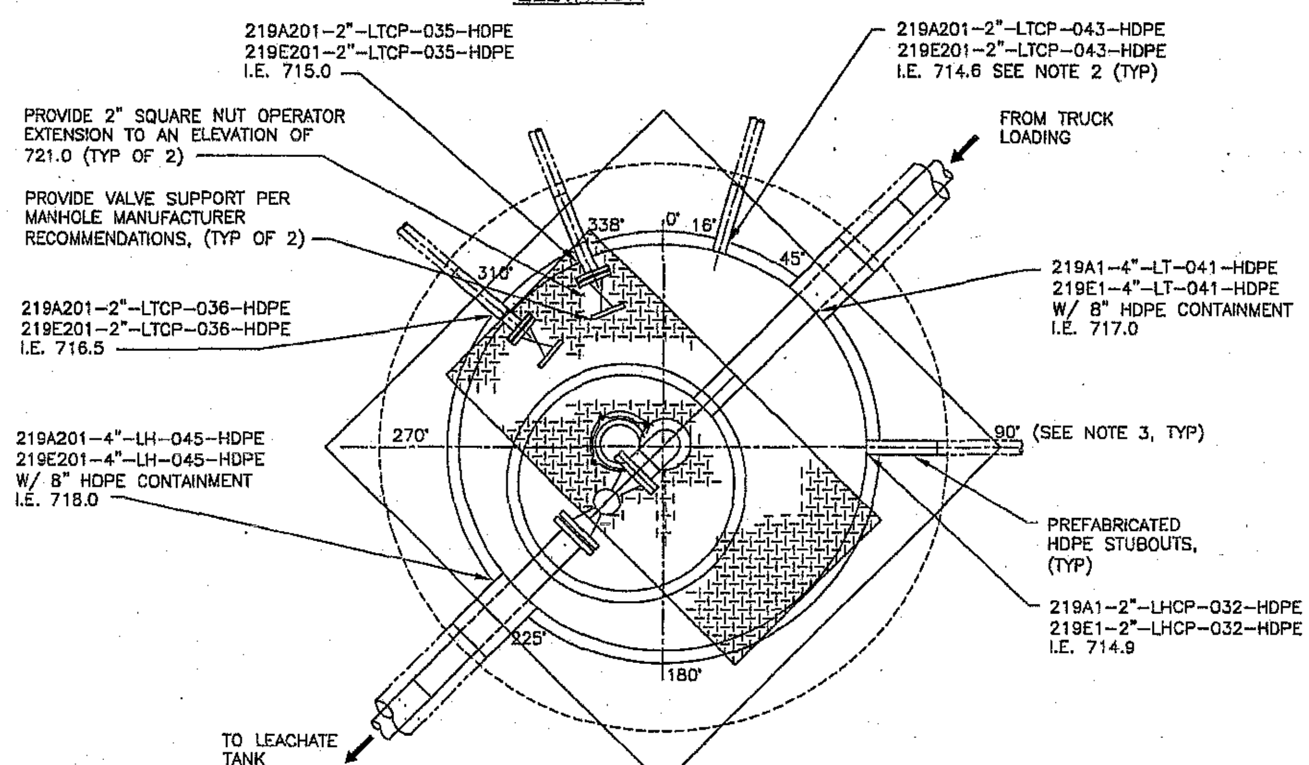


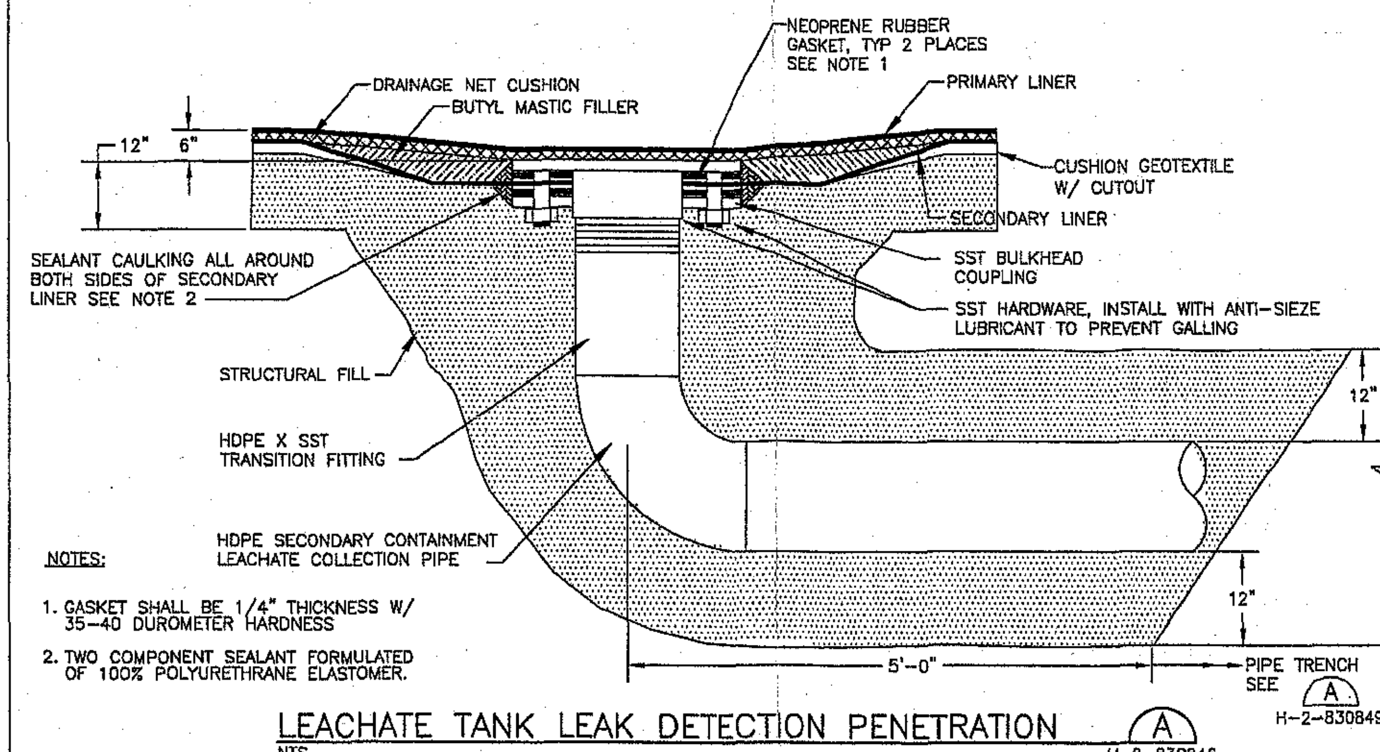
PLAN

COMBINED SUMP MANHOLE (1)

NTS H-2-830846

NOTES:

1. INSTALL 4 BOLLARDS AROUND ACCESS HATCH.
2. PIPING AND EQUIPMENT DESIGNATIONS ARE IDENTIFIED FOR CELL 1 AND CELL 2. THE "219A" PREFIX IS FOR CELL 1 AND THE "219E" PREFIX IS FOR CELL 2.
3. MANHOLE STUBOUT ANGLES AND INVERT ELEVATIONS SHALL BE FIELD VERIFIED PRIOR TO FABRICATION OF MANHOLE.
4. PROVIDE DISTANCE AS REQD TO BUTT FUSE IN FIELD, TYP.
5. PROVIDE FUSION WELDED GUSSETED, SHOP FABRICATED PENETRATION CONNECTIONS. NO FIELD WELDS, TYP.

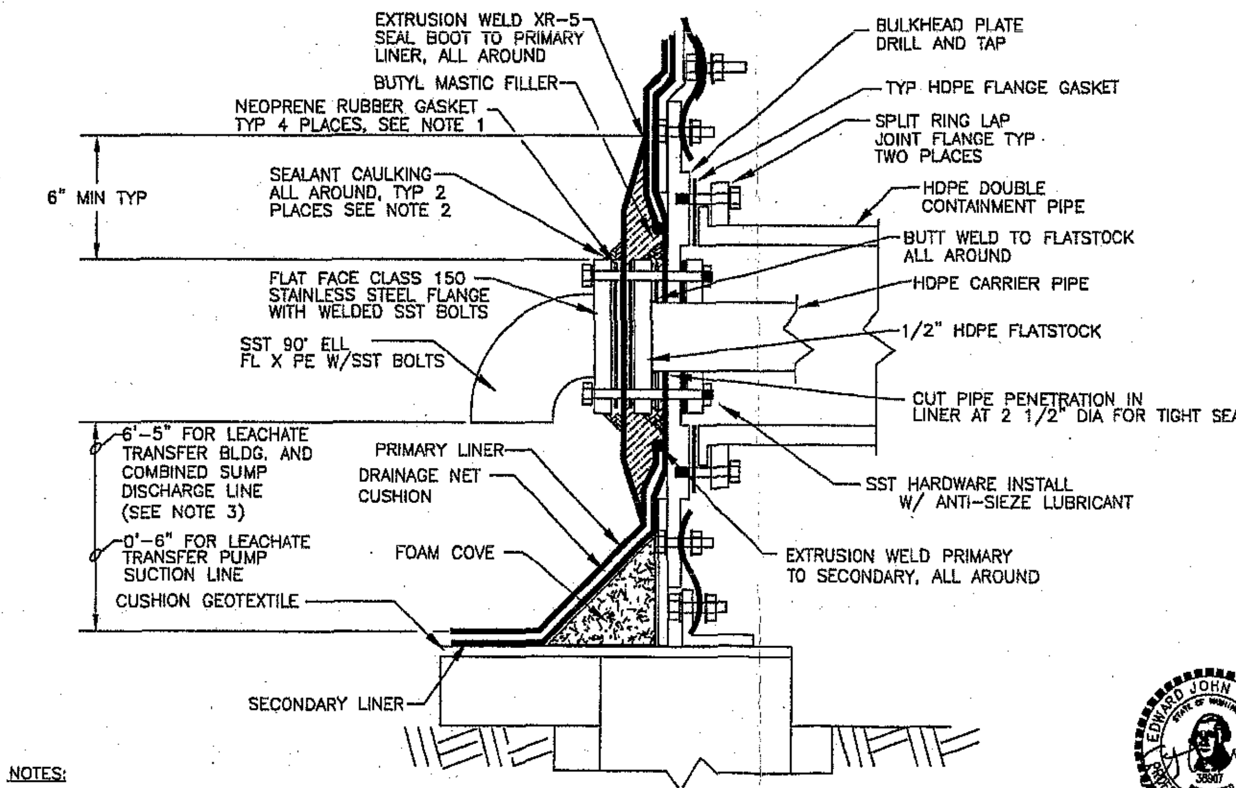


NOTES:

1. GASKET SHALL BE 1/4" THICKNESS W/ 35-40 DUROMETER HARDNESS
2. TWO COMPONENT SEALANT FORMULATED OF 100% POLYURETHRANE ELASTOMER.

LEACHATE TANK LEAK DETECTION PENETRATION (A)

NTS H-2-830846



NOTES:

1. GASKET SHALL BE 1/4" THICKNESS W/ 35-40 DUROMETER HARDNESS.
2. TWO COMPONENT SEALANT FORMULATED OF 100% POLYURETHRANE ELASTOMER.
3. PROVIDE MIN. OF 2 PIPE SUPPORTS PER DISCHARGE LINE. PIPE SUPPORTS SHALL CONNECT TO TANK WALL PER TANK MANUFACTURER'S REQUIREMENTS.

LEACHATE TANK WALL PENETRATION (B)

NTS H-2-830846

BLDG. NO. 200E

INDEX NO. 8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

EDWARD JOHN THOMAS, STATE OF WASHINGTON, 35607, REGISTERED PROFESSIONAL ENGINEER, EXPIRES 8/4/05

CH2MHILL

DWG NO	TITLE	REF NUMBER	TITLE
			REFERENCES
DRAWING TRACEABILITY LIST		NEXT USED ON	

REVISIONS

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
LCRS / LDS
SECTIONS AND DETAILS

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	200E	8500	H-2-830850	A

SCALE AS SHOWN | 634144 | SHEET 1 OF 1

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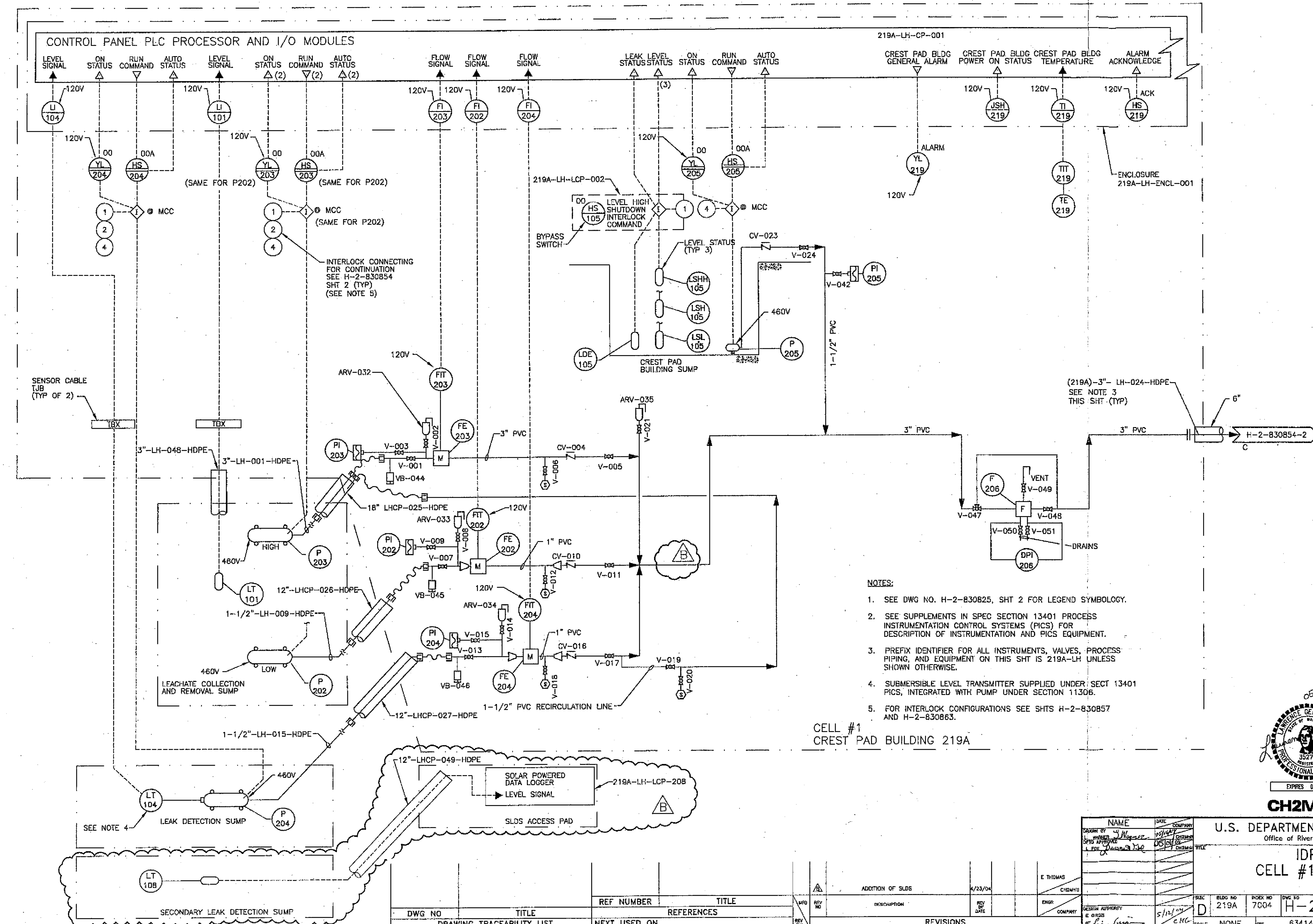
8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



NOTES:

1. SEE DWG NO. H-2-830825, SHT 2 FOR LEGEND SYMBOLOGY.
2. SEE SUPPLEMENTS IN SPEC SECTION 13401 PROCESS INSTRUMENTATION CONTROL SYSTEMS (PICS) FOR DESCRIPTION OF INSTRUMENTATION AND PICS EQUIPMENT.
3. PREFIX IDENTIFIER FOR ALL INSTRUMENTS, VALVES, PROCESS PIPING, AND EQUIPMENT ON THIS SHT IS 219A-LH UNLESS SHOWN OTHERWISE.
4. SUBMERSIBLE LEVEL TRANSMITTER SUPPLIED UNDER SECT 13401 PICS, INTEGRATED WITH PUMP UNDER SECTION 11306.
5. FOR INTERLOCK CONFIGURATIONS SEE SHTS H-2-830857 AND H-2-830863.

CELL #1
CREST PAD BUILDING 219A

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

REV	DESCRIPTION	DATE
B	ADDITION OF SLDS	4/23/04

REVISIONS

E THOMAS CH2MHILL

BLDG. NO. 219A 219A1 219A201 219E 219E1 219E201

INDEX NO.

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

LAWRENCE GERARD BOX REGISTERED PROFESSIONAL ENGINEER 35278 STATE OF WASHINGTON
05/06/04
EXPIRES 09/18/05

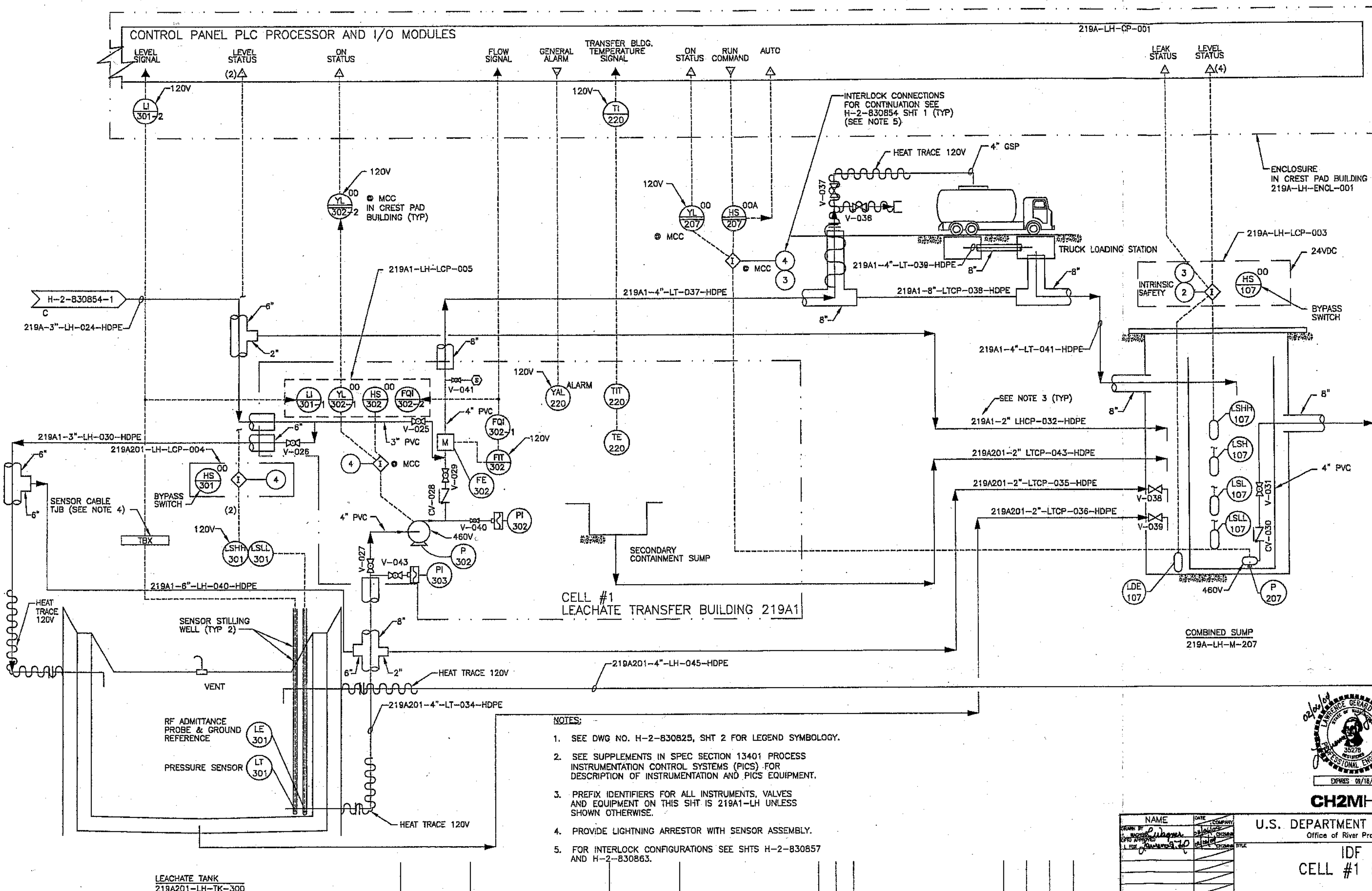
CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
CELL #1 P&ID

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	219A	7004	H-2-830854	B
SCALE NONE		EDT 634144	SHEET 1 OF 4	

DRAWN BY L. WARNER · CHECKED · APPROVED L. FOX · DESIGN AUTHORITY E. ORGIS 5/12/04 CHG



NOTES:

1. SEE DWG NO. H-2-830825, SHT 2 FOR LEGEND SYMBOLOGY.
2. SEE SUPPLEMENTS IN SPEC SECTION 13401 PROCESS INSTRUMENTATION CONTROL SYSTEMS (PICS) FOR DESCRIPTION OF INSTRUMENTATION AND PICS EQUIPMENT.
3. PREFIX IDENTIFIERS FOR ALL INSTRUMENTS, VALVES AND EQUIPMENT ON THIS SHT IS 219A1-LH UNLESS SHOWN OTHERWISE.
4. PROVIDE LIGHTNING ARRESTOR WITH SENSOR ASSEMBLY.
5. FOR INTERLOCK CONFIGURATIONS SEE SHTS H-2-830857 AND H-2-830863.

BLDG. NO.: 219A, 219A1, 219A201, 219E, 219E1, 219E201

INDEX NO.

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

LAWRENCE GERARD FIX — PROFESSIONAL ENGINEER — 35278 — EXPIRES 09/18/05 — 02/04/05

CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

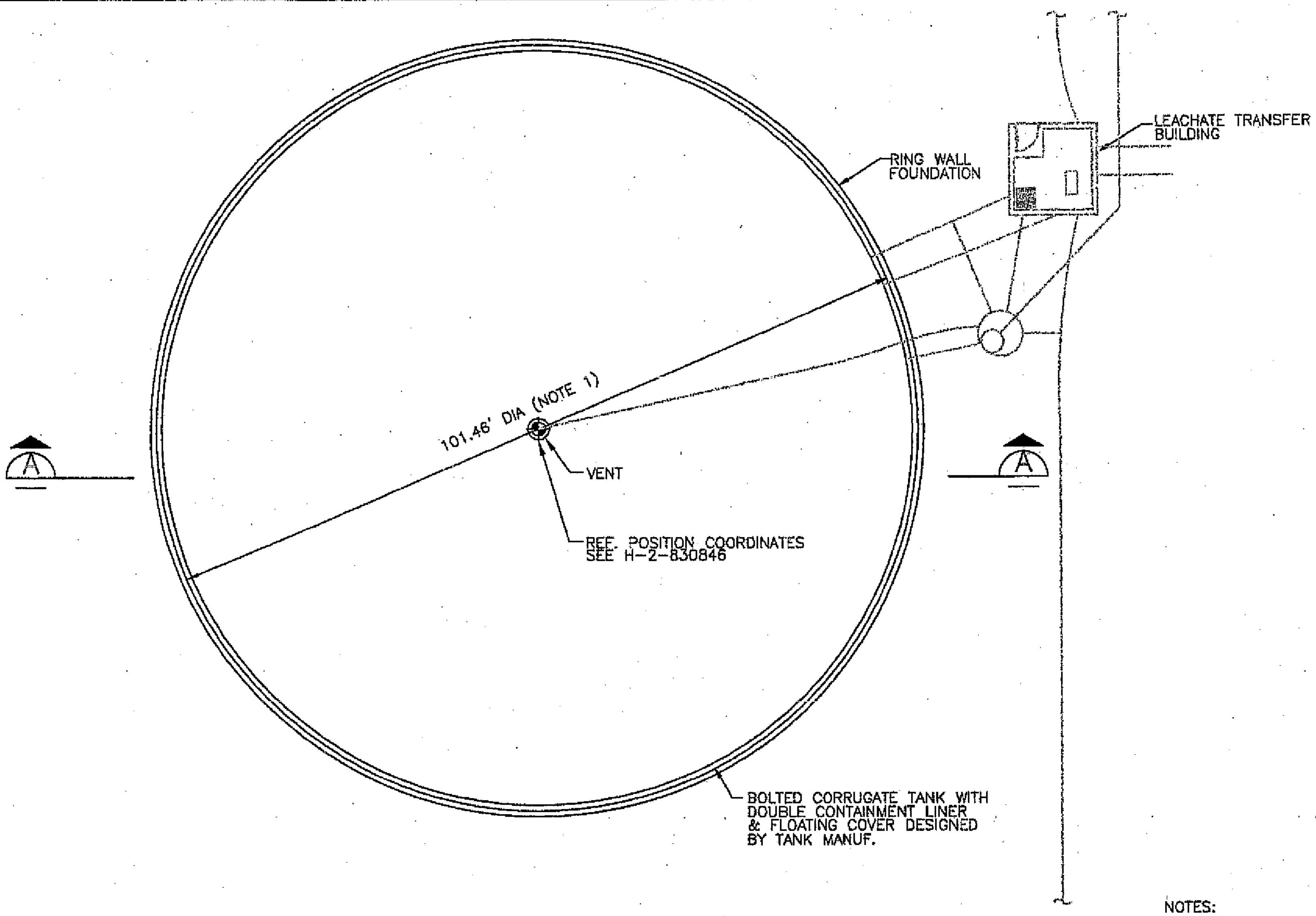
IDF
CELL #1 P&ID

SIZE	BLDG NO	INDEX NO	DWG NO	REV
D	219A1 219A201	7004	H-2-830854	A

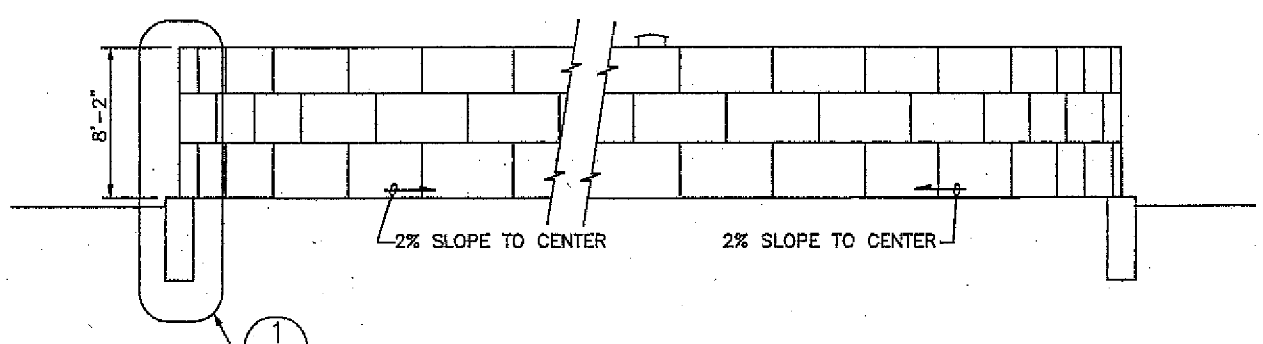
SCALE NONE — 634144 — SHEET 2 OF

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		NEXT USED ON	REFERENCES

REVISIONS



FLOOR AND ROOF PLAN
3/32"=1'-0" TYP FOR 219A201 & 219E201

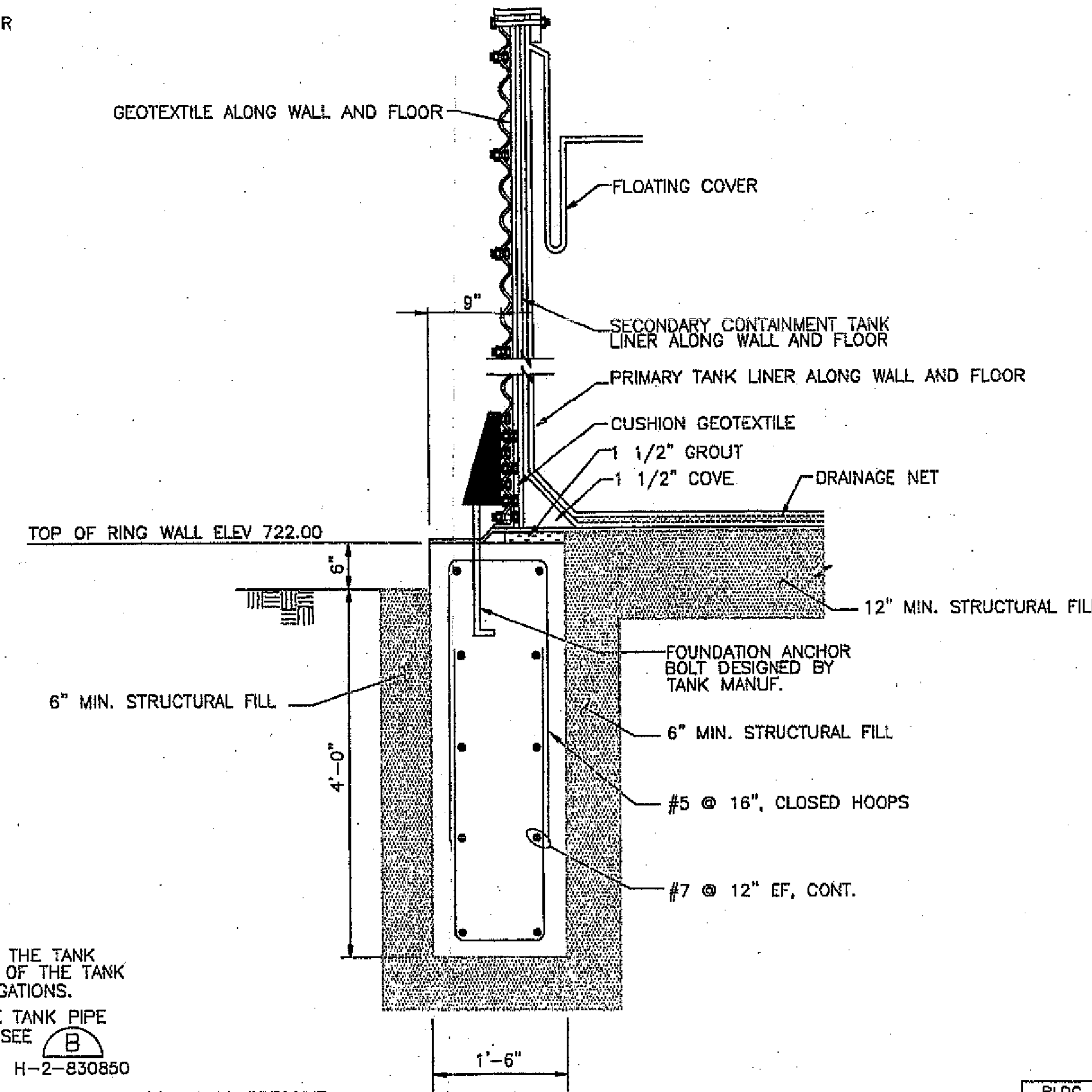


SECTION A
3/16"=1'-0"

NOTES:

1. DIAMETER FOR THE TANK REFERS TO ℄ OF THE TANK SHELL CORRUGATIONS.
2. FOR LEACHATE TANK PIPE PENETRATION, SEE B / H-2-830850
3. CONCRETE STRENGTH: MIN 4000 psi COMPRESSIVE (CLASS 40) @ 28 DAYS

   REINFORCING STEEL: ASTM 615, GRADE 60



DETAIL 1
1"=1'-0"

BLDG. NO.
219A201 219E201
INDEX NO.
0900

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

SHINJI GOTO, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER
02/06/04
EXPIRES 7/27/04

CH2MHILL

U.S. DEPARTMENT OF ENERGY
Office of River Protection

IDF
LEACHATE TANK FOUNDATION
PLAN, SECTION & DETAIL

NAME	DATE
DRAWN BY R LATTA	2/6/4
DSGN APPROVED S GOTO	2/6/4
DESIGN AUTHORITY E GREGG	2/9/04
SIZE	D
BLDG NO	219A201 219E201
INDEX NO	0900
DWG NO	H-2-830869
REV	A
SCALE	AS SHOWN
	634144
SHEET	1 OF 1

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

REV NO	DESCRIPTION	REV BY DATE
REVISIONS		

XXXX PLOTID XXXX

DRP_TB_D (12-03).DWG

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Appendix 4B **Detailed Design Cell 1 Construction Quality Assurance Plan**

Figures

Tables

Acronyms

ASTM	American Society for Testing and Materials
CDN	Composite drainage net
CM	Construction Manager
CQA	Construction Quality Assurance
CQC	Construction Quality Control
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GCL	Geosynthetic clay liner
GRI	Geosynthetic Research Institute
IDF	Integrated Disposal Facility
LCRS	Leachate collection and removal system
LDS	Leak detection system
NCR	Non-Conformance Report
ORP	Office of River Protection
OSHA	Occupational Safety and Health Administration
PM	Project Manager
QA	Quality assurance
QC	Quality control
RFI	Request for Information
SBL	Soil bentonite admix liner
SLDS	Secondary leak detection system
UCL	Upper control limit
WAC	Washington Administrative Code

SECTION 1–GENERAL

1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Plan describes the quality assurance (QA) activities for constructing Phase I of the Integrated Disposal Facility (IDF) at the Hanford facility in Richland, Washington.

1.1.1 Applicable Units

QA activities will be required during construction of Cell 1 of Phase I to certify that the following construction activities are performed in accordance with the construction documents:

- Construction/preparation of foundation systems for liners
- Construction of dikes or embankments
- Construction of low-permeability soil liners
- Construction of geomembranes
- Construction of leachate collection and removal systems and leak detection systems

This CQA Plan has been prepared to describe the activities that will be performed during construction of the lining system, leachate collection and leak detection systems, and operation layer of Cell 1. This CQA Plan is intended to satisfy the regulatory requirements and guidance established in 40 CFR 264.19, the U.S. Environmental Protection Agency's (EPA) technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993), and Washington Administrative Code (WAC) 173-303-335.

This CQA Plan will be implemented by a CQA Officer (herein referred to as the CQA certifying engineer), a person familiar with EPA's technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* and this CQA Plan. The CQA certifying engineer will be supported by the number of CQA representatives necessary to implement the requirements in this CQA Plan and to document the work.

1.1.2 Scope

This CQA Plan establishes general administrative and documentation procedures that will be applicable for selected activities of construction. With respect to responsibilities, personnel qualifications, and specific inspection and testing activities, this CQA Plan addresses only those activities associated with the soils, geosynthetics, and related liner and leachate collection system piping components for the IDF.

The CQA requirements are divided into the following sections to provide quick access to CQA requirements for individual liner components:

- Soils CQA
- Geosynthetic Clay Liner CQA
- Geomembrane CQA
- Geotextile CQA
- Composite Drainage Net CQA
- Polyethylene Pipe and Fittings CQA
- CQA Documentation and Certification
- CQA Documentation and Certification

1.2 PROJECT ORGANIZATION

This section describes the anticipated project organization for the IDF construction activities. The following subsections address the organizations involved in the construction, their respective roles in construction activities, and the methods of interactions between organizations.

1.2.1 Responsibility and Authority

The organization chart for the IDF construction is shown in Figure 1-1. These personnel will be associated with two main entities that include the Tank Farm operating contractor and his agents and the construction general contractor and his personnel and/or subcontractors. The project team consists of both full-time field personnel and part-time management personnel. The part-time management personnel will be onsite during the IDF construction periodically to monitor progress, attend meetings, resolve disputes, and ensure that the work is implemented in accordance with the construction drawings, technical specifications, CQA Plan, and the RCRA permit. The field personnel will consist of the key personnel onsite during construction. The solid lines on the organization chart represent project responsibilities such as scope, cost, and schedule. The dashed lines represent the functional responsibilities of staff for QA, design, and management. The responsibilities and reporting requirements for each project team member are described in the following sections.

1.2.1.1 Project Team

When the individuals identified below are designated to perform specific functions described in this CQA Plan, the reference to these individuals includes their designee or an alternate who can function on their behalf. The Department of Energy – Office of River Protection (DOE-ORP) Manager is the owner's representative and is responsible for project funding and overall project scope. The DOE-ORP manager and IDF project manager keep the regulatory agencies informed of IDF construction activities and progress.

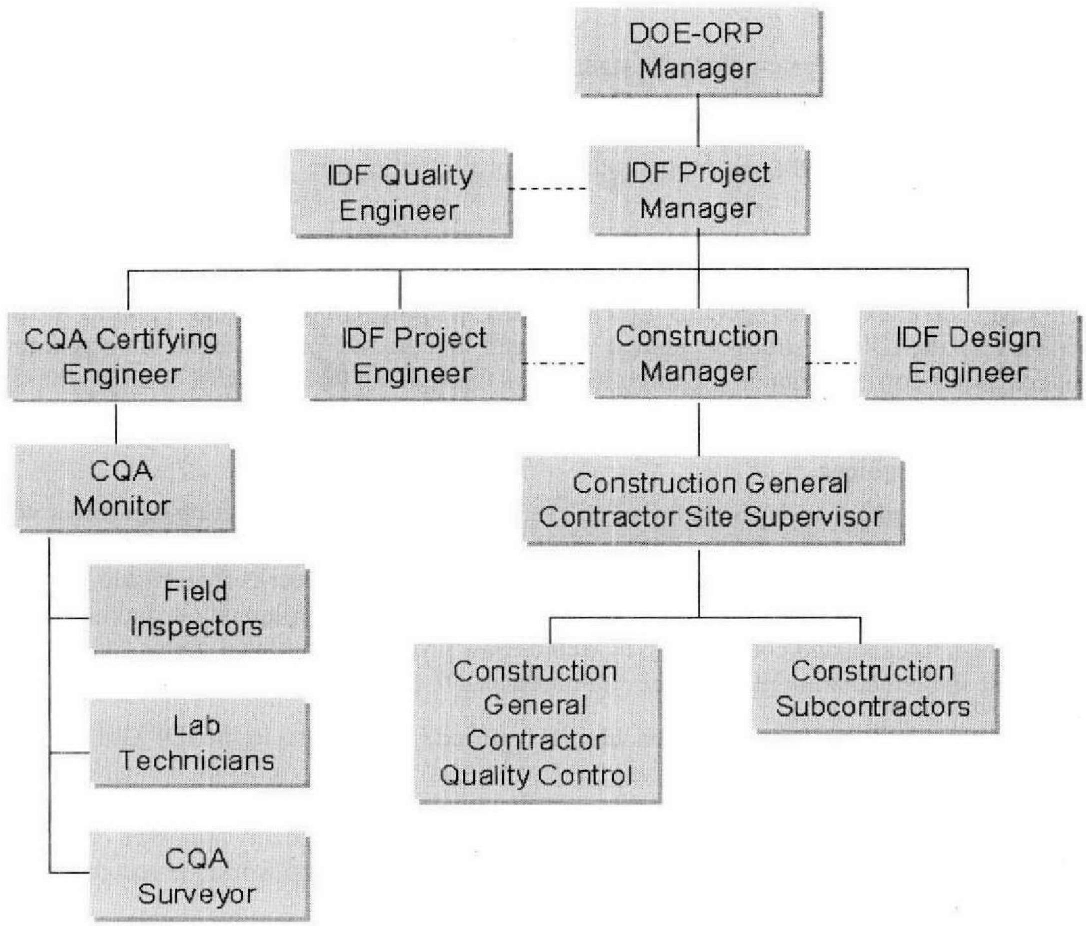
IDF Project Manager (PM)

The IDF PM is an employee or agent of the Tank Farm operating contractor, has overall responsibility for the IDF construction, and interfaces with the DOE-ORP manager. The IDF PM directs the activities of the IDF project and field team staff, including the CM, design engineer, and the project engineer. Additionally, the IDF PM has overall responsibility for the achievement of quality. Functionally, the IDF PM reviews and approves quality assurance reports submitted by the IDF CQA certifying engineer.

IDF Project Engineer

The IDF project engineer is an employee or agent of the Tank Farm operating contractor and is responsible for providing technical support to the IDF project team. The IDF project engineer is supported by the design engineer for reviewing and/or preparing technical documents related to engineering design and analyses.

1 **Figure 1-1. QA Organization Chart**



2

IDF Quality Engineer

The IDF quality engineer is an employee or agent of the Tank Farm operating contractor and is independent from line management on the project. The IDF quality engineer provides overview and assessment of QA on the project. The IDF quality engineer provides feedback and assessment results to the IDF PM.

IDF Design Engineer

The IDF design engineer is an employee or agent of the Tank Farm operating contractor is responsible for reviewing and/or preparing technical documents related to the IDF design and construction. The design engineer prepares the construction drawings, technical specifications, and the CQA Plan. The IDF design engineer reports to the IDF PM and supports the IDF project engineer.

1.2.1.2 Field Team

IDF Construction Manager

The IDF CM is an employee or agent of the Tank Farm operating contractor and serves as the point of contact between the IDF construction general contractor and the IDF project team. All construction general contractor correspondence and direction flows through the CM. The CM oversees the daily construction field activities and is the onsite representative for the IDF PM.

CQA Certifying Engineer

The CQA certifying engineer is an employee or agent of the Tank Farm operating contractor who has the overall responsibility of implementing this CQA Plan and directly supervises the CQA monitor, field inspection team, and laboratory technicians. The CQA certifying engineer is responsible for preparation of an implementation plan that addresses how the CQA Plan is to be implemented, and how CQA work is to be performed, tracked, and coordinated, as well as how procedures outlined in this CQA Plan are to be followed. The implementation plan will be submitted to IDF project manager and CM for approval.

Functionally, the CQA certifying engineer submits certified CQA reports to the IDF CM for review and approval by the IDF PM. The CQA certifying engineer is a registered professional engineer in Washington and has the authority to provide a certification letter that the IDF is constructed in accordance with the approved CQA Plan, the approved plans and specifications, and any approved changes. The CQA certifying engineer also has the authority and responsibility to stop work and recommend remedial actions to the IDF PM.

Field Inspector

Field inspectors are employees or agents of the Tank Farm operating contractor and report to the CQA certifying engineer. The field inspector's function is to perform testing and observations, in accordance with this CQA Plan and under the direction of the CQA monitor and CQA certifying engineer.

Soils Laboratory Technicians

Laboratory technicians are employees or agents of the Tank Farm operating contractor and report to the CQA certifying engineer and provide the QA laboratory testing, required by this CQA Plan and as requested by the CQA monitor and CQA certifying engineer.

CQA Surveyor

The CQA surveyor will be an employee or agent of the Tank Farm operating contractor and will be a registered land surveyor in the State of Washington.

CQA Monitor

The CQA monitor is an employee or agent of the Tank Farm operating contractor, reports directly to the CQA certifying engineer, and is a CQA representative, supported by the field inspection team and laboratory technician. The CQA monitor ensures that all CQA tests are performed in accordance with this CQA Plan and accepted procedures.

Construction General Contractor

The IDF construction general contractor is responsible for implementing the approved design by providing the necessary labor, equipment, materials, and all other resources necessary to construct the IDF.

Construction General Contractor Site Supervisor

The site supervisor is an employee or agent of the construction general contractor and is responsible for implementing the IDF construction activities. The site supervisor has overall responsibility for all construction activities related to the IDF, controls day-to-day construction tasks, and is the point of contact for construction general contractor field personnel. The site supervisor ensures the work is progressing in accordance with approved construction contract documents and the approved schedule.

Construction Subcontractors

Construction subcontractors include specialty companies, retained by the IDF construction general contractor, to perform specific work activities at the IDF such as earth moving, geosynthetic lining installation, piping, and building/tank installation. The construction subcontractors report directly to the construction general contractor site supervisor.

Construction General Contractor Quality Control

The construction general contractor provides a construction QC engineer who supports the site supervisor. The primary responsibility of the construction QC engineer is to ensure that the work is performed in accordance with the technical specifications and construction drawings. Specific duties of the construction QC engineer include activities such as preparing construction submittals, field documentation, and interfacing with the CQA certifying engineer.

1.2.2 Project Meetings

The various progress and status meetings that are anticipated to be held throughout the IDF construction are described below. The purpose of the meetings is to discuss work progress, planning, and other issues related to construction. A portion of these meetings can be dedicated to CQA issues, as necessary, to provide an opportunity for the CQA team to express concerns regarding quality, relay test results, and ensure good communication between all organizations involved in the construction of the IDF.

1.2.2.1 Pre-Construction Meeting

A pre-construction meeting will be scheduled prior to beginning construction activities for the IDF. At a minimum, the meeting will be attended by IDF staff including the PM, CM, project engineer, design engineer, as well as the construction general contractor site supervisor, and the CQA certifying engineer. A portion of the meeting will be dedicated to the discussion of QA issues. Suggested CQA topics will include, but not be limited to:

- Reviewing the responsibilities of each organization
- Discussing the authority of agencies and project and field team members to order work stoppages
- Reviewing lines of authority and communication for each organization
- Providing each organization with all relevant CQA documents and supporting information
- Familiarizing each organization with the CQA Plan and its role, relative to the design criteria, plans, and specifications
- Discussing the established procedures or protocol for observations and tests, including sampling strategies
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and re-testing, including "stop work" conditions
- Reviewing methods for documenting and reporting inspection data
- Reviewing methods for distributing and storing documents and reports
- Reviewing work area security and safety protocol
- Reviewing the proposed project schedule
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events
- Determining action items, assigning actionees, and recording minutes to be transmitted to meeting attendees
- Discussing document control requirements and control of CQA records
- Discussing control and protection of samples

1.2.2.2 Daily Pre-Job Briefing

The construction general contractor will conduct daily pre-job briefings at the work area. The participants will include the construction field personnel, including lower tiered subcontractors and CQA representatives. The primary purpose of these meetings will be to address the day's planned activities. The CQA monitor will discuss CQA activities planned for that day and interface needs with the construction personnel. Suggested CQA topics are:

- Review the work location and activities for the day
- Discuss the construction general contractor's personnel and equipment assignments for the day
- Address scheduling of resources for upcoming work
- Review any new test data
- Discuss any potential construction problems, including unexpected subsurface conditions
- Discuss CQA-planned activities and interface needs

This meeting will be documented and the documentation will be retained on file by the CQA monitor.

1.2.2.3 Construction Progress Meetings

Weekly progress meetings will be held at the site to discuss construction progress. At a minimum, the weekly progress meetings will be attended by the IDF PM, CM, the site supervisor, and the CQA certifying engineer or CQA monitor. The purposes of the meeting are to:

- Review previous activities and accomplishments
- Review claims, change orders, delays, and similar items
- Review planned activities for the upcoming 2-week period
- Finalize resolution of problems from previous meetings
- Discuss potential problems with the work planned for the upcoming 2-week period

Minutes will be recorded and transmitted to meeting attendees and other interested parties.

1.2.2.4 Non-Conformance Meetings

Meetings will be convened as necessary to address non-conformances discovered during inspection. Deficiencies observed during construction by the CQA representatives will be brought to the attention of the IDF CM and CQA certifying engineer and documented using the non-conformance reporting (NCR) procedures outlined in Section 8.1.4. These deficiencies also will be tracked in the CQA representative's field log book until resolution and included in the daily summary report. These documents will include the description of the deficiency and actions taken or to be taken to resolve.

1.2.3 Hold Points

Mandatory hold points will be established for certain key activities. At these points, the IDF construction general contractor will notify the CQA monitor or CQA certifying engineer that the layer or portion of a layer is ready for review. The hold points anticipated for the IDF would be at completion or partial completion of each of the following components:

- Prepared subgrade
- SLDS geomembrane and composite drainage net (CDN)
- SLDS riser pipe
- Soil bentonite admix soil liner
- Secondary GCL
- Secondary geomembrane
- LDS CDN
- LDS piping
- Primary geosynthetic clay liner (GCL)
- Primary geomembrane
- Cushion geotextile
- LCRS piping
- Drain gravel
- Separation geotextile
- Operations layer

On side slopes, a LCRS CDN would substitute for the cushion geotextile, drain gravel, and separation geotextile.

1.3 PERSONNEL QUALIFICATIONS AND TRAINING

This section describes the qualifications and training required for CQA personnel. All documentation relating to qualifications will be maintained with the project CQA records.

1.3.1 CQA Certifying Engineer

The CQA certifying engineer will have landfill construction certification experience. The CQA certifying engineer will, at a minimum, be a registered civil professional engineer in good standing in the State of Washington, possess a bachelor's degree in civil or construction engineering, geotechnical engineering, engineering geology, or a closely related discipline, and have sufficient practical, technical, and managerial experience to successfully direct the CQA activities discussed in this CQA Plan. The CQA certifying engineer's qualifications will be documented by training records and a professional resume showing significant field experience in landfill construction and low permeability soil-bentonite admix liner construction, having directed CQA activities at a minimum of three landfill construction projects or a minimum of 100 acres of combined landfill area certifying experience. The CQA certifying engineer will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993). Qualification documentation will be reviewed by the IDF PM and IDF project engineer.

1.3.2 CQA Monitor

At a minimum, the CQA monitor will have a high school diploma and at least five years of construction-related experience, including at least three years of experience conducting CQA monitoring for earthwork construction (including a minimum of three landfill construction projects or a minimum of 50 acres of combined landfill area experience), or a bachelor of science degree from a four-year college or university and at least two years of experience conducting CQA monitoring for earthworks construction (including a minimum of three landfill construction projects). The CQA monitor must be capable of performing work with little or no daily supervision. The CQA monitor will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993). Qualifications of the CQA monitor will be documented by training records and a professional resume, reviewed by the IDF PM and CQA certifying engineer.

1.3.3 Field Inspector

At a minimum, the field inspector will have a high school diploma and at least two years of construction-related experience, including at least one year of experience conducting CQA monitoring for earthwork construction, or will have a bachelor of science degree from a four-year college or university and at least six months of experience conducting field inspection for earthworks construction. The field inspector must be capable of routine engineering technician work, under general daily supervision. The field inspector will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993). Qualifications of the field inspector will be documented by training records and a professional resume, reviewed by the IDF PM and CQA certifying engineer.

1.3.4 Soils Laboratory Technicians

Laboratory technicians will have at a minimum a high school diploma and at least five years of construction materials laboratory testing related experience, including at least three years of experience performing geotechnical laboratory tests for earthwork construction, including compacted low permeability soil-bentonite admix, or will have a bachelor of science degree from a four-year college or university and at least two years of experience performing geotechnical laboratory tests for earthwork construction, including low permeability soil-bentonite admix. The laboratory technician must be capable of routine laboratory tech work, under general daily supervision. Qualifications of laboratory technicians, including training records and professional resumes, will be reviewed by the IDF PM and CQA certifying engineer.

1.3.5 Geosynthetic Laboratory

The geosynthetic laboratory will be selected by the CQA certifying engineer and will provide the geosynthetic QA conformance testing required by this CQA Plan, as requested by the CQA monitor and/or CQA certifying engineer. The geosynthetics CQA laboratory will be unaffiliated with the materials supplier or manufacturer, or construction general contractor. The geosynthetics CQA laboratory will have at least five years of experience in testing geosynthetics and other relevant liner system components, and will be familiar with American Society for Testing and Materials (ASTM) and other applicable test standards.

1.4 DEFINITIONS RELATING TO CONSTRUCTION QUALITY ASSURANCE

1.4.1 Construction Quality Assurance and Construction Quality Control

Construction Quality Assurance—A planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

Construction Quality Control (CQC)—Those actions that provide a means to measure and control the characteristics of an item or service to meet contractual and regulatory requirements.

1.4.2 Use of the Terms in This Plan

The definitions used in the context of this CQA Plan are as follows:

- CQA refers to means and actions employed by the CQA representatives to assure conformity of liner system, LCRS, LDS, SLDS, and pipe preparation, production, and installation with this CQA Plan, the technical specifications, and the construction drawings. CQA will be provided by a third party, acting independently from the product manufacturer and construction general contractor.

- CQC refers to those actions taken by manufacturers, suppliers, or construction general contractor, including their designated representatives, to ensure that the materials and the workmanship meet the requirements of the technical specifications and the construction drawings.

1.5 REFERENCES

1.5.1 Applicable Organizations

Organizations whose standards are referenced in the CQA Plan include:

- ASTM—American Society for Testing and Materials
- DOE—Department of Energy
- GRI—Geosynthetic Research Institute
- OSHA—Occupational Safety and Health Administration
- EPA—U.S. Environmental Protection Agency

1.5.2 Applicable Standards

Any reference to standards of any society, institute, association, or governmental agency will pertain to the edition in effect as of the date of this CQA Plan, unless stated otherwise.

Specific test standards for tests cited in the CQA Plan are provided in the technical specifications. These standards may be modified due to technological advances since compilation of the technical specifications. All such modifications are to be approved in accordance with change order procedures described in Section 8.1.5.

1.6 CONSTRUCTION ACTIVITIES AND SUBMITTAL REQUIREMENTS

1.6.1 Construction Activities

This section describes the construction activities and submittal requirements that will be performed by the construction general contractor during the IDF construction. This CQA Plan only addresses selected activities of the Phase I construction.

In general, construction activities will consist of preparing the subgrade, installing the liner system, the leak detection systems (LDS and SLDS), the leachate collection and removal system (LCRS), and operations layer and necessary equipment to complete the landfill for waste acceptance. Construction will consist of these activities:

- Mobilizing construction equipment and personnel
- Vendor data submittals
- Installing sediment and erosion control
- Preparing soil bentonite material
- Excavation, embankment, fine grading of landfill subgrade, and sump construction
- Constructing the secondary leak detection system (SLDS) sump
- Constructing the soil bentonite admix liner (SBL)
- Dust control activities during construction
- Placing the geosynthetics for the secondary liner
- Constructing the leak detection system (LDS)
- Placing the geosynthetics for the primary liner
- Constructing the leachate collection and removal system
- Constructing the operations layer
- Site restoration
- Demobilization

Prior to the start of construction activities, the CQA representatives will review and become familiar with all construction drawings, technical specifications, the CQA Plan, and RCRA permit. The CQA certifying engineer also will be familiar with the most recent construction schedule, so that adequate resources (i.e., laboratory, field testing equipment, staff, and CQA forms), including contingencies (e.g., backup equipment, alternate laboratory, and alternate CQA staff) for CQA activities, will be commensurate with the anticipated construction productivity and work schedule.

1.6.2 Submittal Requirements

The construction general contractor will provide the submittals required (listed in Table 1-1 in this section) to the IDF PM. Submittals will be provided far enough in advance of scheduled installation dates to allow time for reviews, possible revisions and resubmittals, placing orders, and securing delivery. The construction general contractor will identify, track, and disposition all required vendor data. The IDF PM will respond to each required submittal as stated in the technical specifications.

The submittals presented in Table 1-1 will be required as a minimum. A master submittal list will be provided as part of the contract documents.

1.6.3 Receipt Inspection Procedures

Inventory of manufactured materials used in lining system construction is detailed in Sections 3.1.4 (GCL), 4.1.4 (geomembrane), 5.1.4 (geotextiles), 6.1.4 (CDN) and 7.1.4 (polyethylene piping). The purpose of this section is to provide a general summary of the minimum requirements and procedures for receiving and controlling purchased materials, equipment, or services as required by the contract documents.

Procurement, receipt, and inspection of construction materials and equipment are the responsibilities of the construction general contractor, with verification by the CQA certifying engineer and IDF CM.

Procedures specific to the IDF Phase I construction project will be prepared as part of the construction quality control (QC) plan, to be submitted by the construction general contractor.

Procedures to control receipt inspection will include the following, at a minimum:

- The contract documents will provide a master submittal list that identifies the materials, equipment, or services requiring receipt inspection. Upon delivery to the project site, the general construction contractor will attach secure and visible "Quality Hold for Inspection" tags to each item.
- All items, materials, and equipment that have been tagged will be stored in segregated areas, as identified in the contract documents. Items will be restricted from further use until all construction general contractor and CQA certifying engineer inspections are completed.
- Upon inspection if items, materials, or equipment held for inspection, the "Quality Hold for Inspection" tag will be removed and replaced with one of the following, as appropriate:
  a) Acceptance tag
  b) Non-conformance (red) tag
  c) Conditional use tag
- The construction general contractor may utilize only those items tagged as "Accepted" or "Conditional Use."
- Red tagged materials will not be used in construction and will be moved to a segregated area or removed from the site.
- Conditional use tagged materials are restricted to use for specific conditions identified on the tag.
- Documentation of receipt inspection will be completed, maintained, and stored in a single location, in a secure and protected environment for the full performance period of the construction contract.

1 **Table 1-1. Required Submittals**

Submittal	Description	Requirement
Source Quality Control for Imported Materials (structural fill, drain gravel and crushed surfacing)	Gradation tests performed in accordance with ASTM D422 by a qualified independent test laboratory for imported materials on samples taken at place of production prior to shipment. Samples will be taken for gradation testing from every 2,000 tons of prepared materials, in accordance with ASTM D75.	Submitted by the construction general contractor and approved by the IDF PM prior to the shipment of material to the project site.
Geomembrane Installation Plan	Proposed layout drawings for each layer of geomembrane material. Geomembrane layout will show panel configuration, general dimensions, and seam locations.	Submitted by the construction general contractor and approved by the IDF PM prior to the installation of the respective geomembrane liner.
Subgrade surface acceptance	Certification in writing that the surface on which the geomembrane will be installed is acceptable to the installer. A certificate of acceptance will be provided by the construction general contractor to the CQA representative, who will then verify to the CQA certifying engineer that the deployment surface has been accepted immediately prior to commencement of geomembrane installation in the area under consideration.	Certificate signed by the installer and construction general contractor prior to installation of geomembrane over the subgrade.
GCL quality control certifications, test data and properties guarantee	Provide manufacturer's quality control (QC) test data for GCL material to be installed, including: Bentonite – suppliers' name and location, brand name, lot number, dated quality control information from supplier, manufacturer's test data verifying that bentonite meets manufacturer's specifications. GCL – written guarantee that GCL conforms to the technical specification requirements and test certificates for each production lot or 50,000 square feet of GCL material including roll numbers, test methods, and test results verifying compliance with the technical specification requirements for GCL.	Submitted by the construction general contractor prior to installation of the GCL material and approved by the IDF PM.

Submittal	Description	Requirement
Geomembrane quality control certifications, test data and properties guarantee	QC Testing shall be performed by manufacturer to demonstrate the geomembrane conforms to technical specification requirements. Prior to delivery of any geomembrane material, the manufacturer shall submit all required information listed in the technical specifications (Section 02661). <u>QC Certification:</u> Prior to shipment, the geomembrane manufacturer shall provide a quality control certificate for each roll of geomembrane. The quality control certificate shall be signed by a responsible party employed by the geomembrane manufacturer, such as the production manager. The quality control certificate shall include: 1. Roll numbers and identification, resin lot, and batch numbers. 2. Sampling procedures and results of quality control tests. As a minimum, results shall be given for thickness, asperity, tensile strength, and tear resistance in accordance with methods indicated in the technical specifications. Tests shall be conducted on each production lot of geomembrane or every 50,000 square feet, whichever results in the greater number of tests.	Submitted by the construction general contractor prior to installation of the geomembrane material and approved by the IDF PM.
Geotextile material certifications and test data	Provide manufacturer's QC test data for geotextile material to be installed, including: Geotextile – written guarantee that geotextile conforms to specification requirements, certification that manufacturer continuously inspected geotextile for presence of needles and found it to be needle-free, and test certificates for geotextile material including roll numbers, test methods, and test results verifying compliance with the technical specifications physical properties for geotextile. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan for each required property in the technical specifications.	Submitted by the construction general contractor prior to installation of the geotextile material and approved by the IDF PM.
Composite drainage net material certifications and test data	Provide manufacturer's QC test data for composite drainage net material to be installed, including: Composite drainage net – manufacturer's specification measured using appropriate test methods, written guarantee that composite drainage net conforms to specification requirements, manufacturer's QC test data for the geotextile component as specified above for geotextile, and test certificates for composite drainage net material and geonet component including roll numbers, test methods, and test results verifying compliance with the technical specification requirements for composite drainage net and geonet. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan for each required property in the technical specifications	Submitted by the construction general contractor prior to installation of the composite drainage net material and approved by the IDF PM.

Submittal	Description	Requirement
Interface Shear Strength test data	Provide data prior to material shipment for the interface friction angle between the textured geomembrane and other materials (including CDN, GCL, and Admix Liner) directly in contact with the geomembrane as specified in Section 02661; and between the CDN and the operations layer as specified in Section 02373 of the technical specifications. Friction angle shall be determined by direct shear testing under fully saturated conditions (ASTM D5321 or D6243 for GCL interface) at low nominal normal loads of both 100, 250, and 500 pounds per square foot (psf), and high nominal normal loads of 2,000, 8,000, and 15,000 psf, except for the CDN/Operations Layer interface which shall be reported at low normal load only. Report results for both peak and large displacement (minimum 2 inches) strength. Perform two interface shear strength tests on each interface under each set of normal loads.	Submitted by the construction general contractor prior to geosynthetic material shipment and reviewed and approved by the IDF PM for conformance with project strength requirements. Allow IDF PM a minimum 20 working days for this evaluation upon receipt of data.
Admix Liner Preparation and Placement Plan	Provide a detailed plan for preparation of the admix material, including a description of the equipment and procedures to be used, personnel qualifications, equipment calibration certificates and methods for monitoring bentonite additions and moisture conditioning. Also provide an admix liner placement plan to specify lift thickness control and to allow for required testing, described in the CQA Plan and technical specifications on the admix liner during placement operations.	Submitted by the construction general contractor prior to start of admix production for approval by IDF PM.
Bentonite QC certificates and test data	Provide bentonite supplier's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that the bentonite proposed for use in the admix complies with the requirements of the technical specifications. The manufacturer shall certify that the bentonite furnished complies with these Specifications. A certificate shall be submitted to the CQA Engineer for each railcar or every three truckloads of bentonite delivered.	Submitted by the construction general contractor prior to start of admix production for approval by IDF PM.
Polyethylene Pipe and Fittings	Provide manufacturer's QC test data for piping and fittings that will be installed on the landfill floors and slopes.	Submitted by the construction general contractor prior to installation of the pipe for approval by the IDF PM.

SECTION II-SOILS CONSTRUCTION QUALITY ASSURANCE

This section discusses the CQA requirements for soil layers including fill placement, subgrade preparation, admix liner, drain gravel, and operations layer.

2.1 FILL PLACEMENT AND SUBGRADE PREPARATION

This section of the CQA Plan addresses the soils components necessary to provide a prepared subgrade for the liner systems and specifies the soils CQA program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and corrective action requirements.

2.1.1 Fill Placement and Compaction

The technical specifications will be followed for the stockpiling, placement, and compaction of earthfill and structural fill. The CQA monitor will monitor the fill placement and compaction to verify and document the following:

- The soil being placed meets the technical specifications requirements for earthfill and structural fill as determined by the test methods and frequencies specified within this CQA Plan and the source quality control submittals.
- The placement surface has been prepared as specified in the technical specifications.
- The compacted lift thickness is in accordance with the requirements of the technical specifications.
- The dry unit weight of the earthfill and structural fill meets specifications as determined by the test methods and frequencies described in Table 2-1 for earthfill and Table 2-2 for structural fill.
- Material placed in permanent stockpiles meets the appropriate specifications for earthfill or structural fill.

2.1.2 Construction Quality Assurance Evaluation

The frequency of soils testing for CQA purposes will conform to the minimum frequencies presented in Table 2-1 for earthfill and Table 2-2 for structural fill. Material properties will be determined from samples collected either immediately after placement or from stockpiles.

Nuclear density meter test methods will be used for the field testing of the in situ dry unit weight of the in-place, compacted fill. Any settlement or other defects in the fill will be backfilled and compacted in accordance with the technical specifications.

Standard count calibrations will be conducted to monitor the aging of the nuclear density gauge sources in accordance with ASTM standards. Sand cone or drive sleeve tests will be conducted periodically to verify densities using the nuclear density gauge. Oven moisture content tests will be conducted and compared to field moisture content results to determine a field correction factor for moisture. Sand cone or drive sleeve tests and in situ moisture content tests will be performed at the frequencies specified in Tables 2-1 and 2-2.

If an in-place density test result fails to meet specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, a CQA representative will determine the extent and nature of the defect by observations and/or additional testing, as necessary, to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the fill, a CQA representative will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA representative deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and remedied by the construction general contractor, the CQA representative will verify that the deficiency has been corrected by re-testing repaired areas before any additional work is performed by the construction general contractor in the area of the deficiency. All confirmatory tests, failing tests, and re-tests will be recorded in the CQA representative's field book or compaction testing form. The approximate location and elevation of each test will be recorded.

The CQA representative will document fill placement and compaction as determined by the test methods and frequency prescribed by this CQA Plan and will report any non-conformance in accordance with the non-conformance reporting procedures outlined in Section 8.1.4.

2.2 PREPARED SUBGRADE

The CQA representative will verify and document that the prepared subgrade is constructed to the elevations and grades shown in the construction drawings, with subgrade meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Upon completion of the excavation of the landfill, the CQA monitor will perform the following tasks:

- Inspect the subgrade on the side slopes and base of the landfill and note areas of weak or excessively weathered subgrade materials
- Observe completion of excavation and subgrade compaction prior to foundation, fill, or liner placement
- Observe the proof rolling of the base of the landfill and note areas that exhibit excessive rutting, heaving, or softening
- Observe that the surface of the subgrade is free of debris, wet and soft areas, standing water, vegetation, mud, ice, or frozen material

- Observe any excavation and backfilling operations associated with unsuitable material found in the prepared subgrade
- Verify that a survey has been conducted to further verify that the subgrade grades and elevations conform to the construction drawings
- Verify that the prepared subgrade material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-3
- Verify that sampling points in the prepared subgrade are plugged or backfilled so that the prepared subgrade meets the technical specifications
- Document the location and volume of any unsuitable material removed from the prepared subgrade and report any non-conformance with the technical specifications in accordance with the non-conformance reporting procedures in Section 8.1.4

2.2.1 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of prepared subgrade is complete prior to constructing the overlying layer. The construction general contractor can proceed with the overlying layer upon acceptance of the area of prepared subgrade by the CQA representative. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

2.3 SOIL BENTONITE ADMIX LINER AND TEST PADS

The soil bentonite admix liner (SBL) is composed of a mixture of base soil and bentonite material. Two SBL test pads will include both a horizontal and a sloped test pad. The horizontal test pad will be constructed by using the same compaction methods as that used for the production SBL, to ensure the SBL is constructed to meet the minimum hydraulic conductivity requirements. The sloped test pad will be constructed on a sloping surface to verify that compaction methods (determined during the horizontal test pad) will be adequate for the side slopes of the landfill. If necessary, the technical specifications and/or CQA Plan may be modified, based on the results of the test pads.

2.3.1 Test Pads

Test pads will be constructed by the construction general contractor to determine acceptable placement and compaction methods to produce a low permeable SBL on a horizontal surface and on a 3H:1V side slope that satisfies the performance requirements of the technical specifications.

In addition, the mixing of the base soil and bentonite admixture using the pugmill will be tested to ensure adequate control of the ratio of admixture components as well as the homogeneity of the completed SBL mixture.

2.3.1.1 Construction Quality Assurance Evaluation

During test pad construction, the CQA representative will continuously observe and document the construction of the test pad. These guidelines will be followed to ensure that the test pad accurately represents the performance of the full-scale facility:

- Construction of the test pad will use the same soil material, design specifications, equipment, and procedures as proposed for the full-scale facility.
- The test pad length, width, and depth will be as required by the technical specifications and for the in-situ hydraulic conductivity test spacing.
- The number of lifts used to construct the test pad will be as required by the technical specifications.

The test pad will be constructed to allow determination of the relationship among density, moisture content, and method of compaction. Field variables can affect this relationship and must be carefully measured and controlled, both in the test pad and during construction of the full-scale liner. At a minimum, the following will be observed and documented:

- Track weight of base soil and bentonite during mixing operations
- Mixing operation homogeneity
- Test pad configuration and dimensions
- Compaction equipment type, configuration, and weight
- Number of passes and speed of the compaction equipment
- Uncompacted and compacted lift thickness
- Weather conditions, including ambient temperature, humidity, wind speed and direction, and precipitation

The CQA representative will provide the necessary surveying and/or reference grid points for adequately and expeditiously determining the elevation and dimensions of the test pad, including each lift.

The CQA representative will be responsible for all testing, surveying, and documentation necessary to verify that the test pad performs in accordance with the technical specifications, and that the methods, equipment, and materials used can achieve the same results or better during full-scale construction.

Testing methods and frequencies will be as indicated in Table 2-4. Additional tests may be conducted at the direction of the CQA certifying engineer. All tests will be conducted in accordance with the methods and procedures specified in Table 2-4. Tests are separately identified in Table 2-4 which are intended to provide the following:

- Information Only, for use in evaluating overall methods , materials, or equipment
- Pass/Fail, that have criteria established in the technical specifications which must be met
- Calibration and Check, for use in calibrating instruments

The CQA certifying engineer will compare the results of the test pad constructed on the level surface with the results of the test pad on the side slopes. The CQA certifying engineer will recommend changes to compaction methods, if necessary, to the IDF project engineer. The CQA certifying engineer will prepare an interim report which summarizes the construction and testing of the test pads.

It is important to note that an acceptable zone has been established in the technical specifications for the allowable moisture content and density ranges that are applicable for the SBL admix to meet minimum permeability requirements. This zone may be adjusted as a result of the test pad data obtained during construction to reflect specific conditions observed based on the construction general contractor's proposed blending, placement, and compaction methods. With the range of placement moisture content and density allowed with this approach, minimum compaction effort (i.e., the number of passes a piece of compaction equipment needs to bring the admix into the allowable moisture/density zone) will vary based on material conditions and placement location. Minimum compaction effort recommendations will be developed by the CQA certifying engineer for application to both bottom slope and side-slope admix construction based on test pad results. However, these minimums should be considered as guidelines only and may need to be adjusted based on changes to admix properties (primarily moisture content), site conditions, and compaction location as needed to bring the admix into the required acceptable zone for compaction.

2.3.2 Soil Bentonite Admix Liner

The CQA team will verify and document that the SBL is placed to the elevations, grades, and thicknesses shown in the construction drawings, with bentonite-amended material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

2.3.2.1 Construction Quality Assurance Evaluation

CQA testing will be performed during processing and placement of the SBL. The CQA team will conduct the processing and placement tests for the SBL as specified in Table 2-5. The maximum allowable percentage of failing tests is specified in Table 2-6.

Processing

The construction general contractor shall process and condition admix material using a central type pugmill plant as described in the technical specifications. Prior to amending the base soil with bentonite, a CQA representative will verify and document the following:

- Equipment and methods are the same or equivalent as determined from the test pad studies.
- All submittals have been reviewed and approved.
- The base soil source area (either onsite excavation or borrow area) has been approved by the design engineer, IDF PM, or IDF project engineer.
- The mixing equipment is suitable for amending base soils with bentonite.
- The base soil does not contain rocks with dimensions in excess of those required by the technical specifications.

During processing, the CQA representative will verify and document the following:

- The bentonite is in conformance with the technical specifications.
- Close observation of the base soil excavation and processing is performed by the field inspector.
- The processed SBL material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.
- The moisture content and consistency of base soil allow bentonite to be mixed uniformly.
- Bentonite amendments are mixed uniformly with the base soil.
- The processed SBL material is stored, protected, and allowed to cure in accordance with the conditions and minimum requirements of the technical specifications.
- Calibration of the pugmill operation feed rate controls for bentonite, base soil and water.
- The bentonite is mixed at the required application rate, established by the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.

The CQA representative will document the properties of the processed soil bentonite material, as determined by the test methods and frequency prescribed by this CQA Plan, and will report any non-conformance with the technical specifications, following procedures outlined in Section 8.1.4.

The CQA representative will observe processing activities including base soil excavation, bentonite blending, and moisture conditioning.

The CQA representative will monitor the excavation of base soil from the approved borrow source or onsite excavations. Deleterious base soil or base soil not meeting the technical specifications will be identified and reported to the CQA certifying engineer and not allowed in the processing area.

CQA tests will be performed on the raw bentonite used in the SBL to verify conformance to the technical specifications. The CQA representative will collect samples of raw bentonite delivered to the site for testing. The CQA laboratory technician will conduct free swell, and grain size tests of the bentonite in accordance with Table 2-5. If the test results of a sample fail to meet specifications, a confirmatory test will be performed immediately subsequent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed. If the second confirmatory test also meets or exceeds specifications, the bentonite will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, the bentonite will be rejected and removed from the site.

The CQA representative will observe mixing and test the bentonite-amended soil, prior to placing it in the landfill.

Placement

Prior to the placement of the SBL, the CQA representative will verify and document the following:

- The test pads have been constructed with the approved liner material and production scale equipment to confirm placement and compaction procedures produce the required low-permeability admix for both on a horizontal surface and on a 3H:1V side slope.
- All or an approved portion of the prepared subgrade meets specifications as determined by the test requirements of this CQA Plan and the CQA certifying engineer has issued the completion certificate.
- The SBL material is free of roots, stumps, vegetation, or any other type of deleterious material that may impact the performance of the placed SBL.
- The SBL material does not contain stones with dimensions in excess of those required by the technical specifications.

- The SBL material meets or exceeds the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.
- The moisture content of the SBL material is uniform.

During placement and compaction of the SBL, the CQA Team will verify and document the following:

- Close observation of the placement and compaction of SBL material with earthmoving equipment is performed by the field inspectors. Inspectors to verify that means and methods are the same as those approved in the test pad process.
- The SBL material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-5 and is within the maximum allowable failure rates in Table 2-6.
- The SBL is placed in accordance with the conditions and minimum requirements of the technical specifications.
- Each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.
- Shelby tube samples are collected for laboratory permeability testing at the frequency specified in Table 2-5.
- Penetrations in the SBL at testing and sampling locations are repaired in accordance with the technical specifications.
- The SBL is maintained until it is covered by the geomembrane liner in accordance with the technical specifications.
- In areas of inaccessibility by the compactor, in areas of nonstandard SBL placement, and/or in areas of different compaction methods, more frequent testing will be performed due to thinner lift thicknesses to achieve equivalent compactive effort. Each lift, no matter how thin, will be tested for density and moisture in accordance with Table 2-5.

The CQA representative will document the properties of the SBL as determined by the test methods and frequency prescribed by this CQA Plan and will report any non-conformance in accordance with the non-conformance reporting, as outlined in Section 8.1.4.

The CQA representatives will collect samples immediately after a loose lift of SBL materials has been placed for property tests, prior to compaction. Once compacted, nuclear density gauge test methods will be used for testing the in situ compacted dry unit weight and moisture content of the SBL. Standard count calibration and moisture content tests will be used to calibrate the reading of the nuclear density gauge. Standard count calibration and in situ moisture content tests, using the oven dry method, will be performed at the frequencies specified in Table 2-5. The results of the oven dry moisture content tests will be compared with the field moisture content results to determine a field moisture correction factor. The CQA representative will adjust the field moisture correction factor as test data is collected (i.e., moving average). The CQA representative will collect Shelby tube samples of the SBL for laboratory permeability tests as specified in Table 2-5.

If in-place density test results fail to meet specifications, a confirmatory test will be performed immediately adjacent to (within 3 ft of) the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to (within 3 ft of) the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, additional testing will be performed to identify the limits of the area that does not meet project specifications. All confirmatory tests, failing tests, and re-tests will be recorded in the CQA representative's field book or compaction testing form. The approximate location and elevation of each test will be recorded.

Rapid laboratory permeability tests, such as the constant volume tests, will be used when possible to determine permeability. Once the sample has achieved the specified permeability, the test result will be reported immediately to the CQA certifying engineer. The number of failing tests will be less than the maximum percentage of failing tests specified in Table 2-6. The maximum percentage of failing tests are anticipated to cover laboratory or field recording mistakes, math errors, or other unknown circumstances that are not discovered until after the layer is covered with the succeeding layer(s). Otherwise, all failed tests will be corrected in the field as they are observed.

If a defective area is discovered in the SBL other than a failed in-place density test, the CQA representative will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA representative deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and remedied by the construction general contractor, the CQA representative will verify that the deficiency has been corrected by re-testing repaired areas before any additional work is performed by the construction general contractor in the area of the deficiency.

The testing frequency during the SBL construction may be increased or modified at the discretion of the CQA certifying engineer, when visual observations of construction performance indicate potential problems or when field experience with the proposed SBL material have been obtained.

During construction, the frequency of testing may be increased by the CQA representative during adverse weather conditions, if equipment breaks down, at the start and finish of grading, if the material fails to meet the requirements of the technical specifications, or if the extent of the work area is reduced.

The construction general contractor will repair all penetrations in the SBL resulting from sampling and other CQA activities, in accordance with the technical specifications. These perforations will be identified to the construction general contractor by the CQA representative. All repairs will be inspected by the CQA representative.

The construction general contractor will be required to use all means necessary to protect all prior work as well as all materials and completed work of other sections. In the event of damage, the construction general contractor will be required to immediately make all repairs and replacements necessary. The CQA representative will verify and document that all damages are repaired.

2.3.2.2 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of SBL is complete, prior to constructing the overlying layer. The construction general contractor may begin placement of the overlying layer after acceptance of the SBL by the CQA certifying engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

The CQA certifying engineer will ensure all CQA tests are complete and that all defective areas have been repaired and re-tested in accordance with this CQA Plan and the technical specifications. The certificate of layer completion will indicate that the SBL meets the low permeability requirement, based on laboratory tests and the thickness of the SBL meeting the minimum requirement specified in the technical specifications.

2.4 DRAIN GRAVEL

2.4.1 Conformance Evaluation

No CQA conformance material testing is planned for the drain gravel. Construction general contractor is required to submit gradation test results demonstrating conformance with required material properties as part of source quality control, in accordance with the technical specifications.

2.4.2 Placement and Compaction

The CQA representative will verify and document that the drain gravel is constructed to the elevations, grades, and thicknesses shown in the construction drawings, with material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the drain gravel, the CQA representative will verify and document that:

- The underlying geosynthetic layers are free of holes, tears, excessive wrinkles, or foreign objects.
- All work on underlying layers is complete and accepted by the CQA certifying engineer.

During placement and compaction of the drain gravel, the CQA representative will verify and document the following:

- Drain gravel material satisfies the requirements of the technical specifications as determined by the source quality control submittals.
- Drain gravel material is non-angular and free of material that could damage the underlying liner materials.
- Drain gravel material is spread during cooler portions of the day, unless otherwise approved by the CQA certifying engineer.
- Spreading and hauling equipment and operations are in compliance with material thickness and operations requirements, given in the technical specifications.
- If excessive wrinkles begin to develop in the underlying geosynthetics during gravel or sand placement or spreading, the wrinkles are worked out prior to continued placement operations.
- The drain gravel is placed in a manner that will not damage underlying geosynthetics, will minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics, in accordance with the technical specifications.
- Close observation of the placement and compaction of drain gravel with earth moving equipment is performed.

2.4.3 Construction Quality Assurance Evaluation

No density tests will be conducted on the drain gravel. If the CQA representative suspects damage to pipes or underlying geosynthetic, the construction general contractor will be required to expose the potentially damaged materials and repair any observed damage.

2.4.4 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of the LCRS or LDS drain gravel is complete, prior to constructing the overlying layer. The construction general contractor may begin placing the overlying layer when the drain gravel is accepted by the CQA certifying engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

2.5 OPERATIONS LAYER

The CQA representative will verify and document that the operations layer, including the operations layer material placed in the SLDS sump area, is constructed to the elevations, grades, and thicknesses shown in the construction drawings, with material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the operations layer, the CQA representative will verify and document the following:

- The underlying geosynthetic layer is free of holes, tears, excessive wrinkles, or foreign objects.
- All work on underlying layers is complete and accepted by the CQA certifying engineer.

During placement of the operations layer, the CQA representative will verify and document that:

- The soil is suitable and satisfies the requirements of the technical specifications as determined by the test methods and frequencies prescribed in Table 2-7.
- The operations soil is placed in accordance with the technical specifications and construction drawings.
- The lift thicknesses and total thickness of the operations layer agree with the requirements of the construction drawings.
- If excessive wrinkles begin to develop in the underlying geosynthetics during material placement or spreading, the wrinkles are worked out prior to continued placement operations.
- The operations layer is placed in a manner that will not damage underlying geosynthetics, will minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics, in accordance with the technical specifications.
- Spreading and hauling equipment and operations are in compliance with material thickness and operations requirements given in the technical specifications.
- The operations layer is placed on the side slopes to the limits shown in the construction drawings.
- No operations layer material is placed or compacted during periods of unfavorable weather conditions, such as after heavy rains or snow, in accordance with requirements given in the technical specifications.

2.5.1 Conformance Evaluation

The test methods and frequencies for CQA conformance testing for the operations layer are specified in Table 2-7.

If damage to underlying geosynthetics is suspected, the CQA representative will require that the overlying operations layer material be removed to expose the geosynthetics.

The construction general contractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction general contractor will be required to immediately make all repairs and replacements necessary. The CQA representative will verify and document that all damages are repaired.

2.5.2 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of the operations layer is complete. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

2.6 SOIL SURVEYING

A survey will be performed by or under the direction of a professional land surveyor registered in the State of Washington. The surveyor will independently survey the elevations and grades of the soil layers including, but not limited to:

- Top of prepared subgrade
- Top of SBL
- Top of LCRS drain gravel
- Top of operations layer

Surveys will be performed on the base and side slopes of the landfill, to confirm that the grades and elevations in the field agree with those shown in the construction drawings and with the minimum acceptable tolerances required in the technical specifications. The results of the survey, conducted by the surveyor, will be compiled in a report signed by the surveyor and the CQA certifying engineer.

The surveyor will be required to survey each soil layer of the liner system for the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing or tabular listing of surveyed points will be submitted to the CQA certifying engineer by the surveyor before the placement of the next liner system layer. The surveys will be conducted at a 50-ft grid across the entire area of the survey. The survey will include, but not be limited to, the following features of the landfill:

- Toe of slope
- Crest of slope
- Grade breaks
- Anchor trench
- SLDS, LDS and LCRS sumps

Table 2-1. Minimum Frequency of Testing for CQA Evaluation of Earthfill

Test	Frequency	Standard Test Method
Material Properties		
Standard proctor or maximum index density for free-draining soil	1 per 20,000 yd^3 (minimum 1 per source or soil type)	ASTM D698 or ASTM D4253
Placement		
In-place wet unit weight	1 per 5,000 ft^2 per lift	ASTM D2922, D1556
In-place moisture content	1 per 5,000 ft^2 per lift	ASTM D3017, D2216
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per day of fill placement	ASTM D2216

Table

Table

Table

Test	Frequency	Standard Test Method
In-place dry unit weight	1 per lift	ASTM D1556, D2167, or D2937

Notes:
a. Tests for information only
b. Pass/fail tests
c. The average effective confining stress will be 5 psi.
d. Rapid turnaround tests (Method F–Constant Volume) will be used when possible.
e. Calibration check tests

Table

Test	Frequency	Standard Test Method
Standard count calibration (per each nuclear gauge)	1 per day of placement	ASTM D2922/ASTM D3017

a. The test method is described in the technical specification.
b. Not used.
c. Curing is stockpiling the SBL material for 12 hours to allow the bentonite to hydrate.
d. A loose lift thickness is such that the compacted thickness is 6 inches or less.
e. The average effective confining stress will be 5 psi.
f. Rapid turnaround tests (Method F – Constant Volume) will be used when possible.
g. A single pass is defined as forward and back.

1

Table

Shelby tube samples (laboratory

placed (minimum 1 per

e of liner

SECTION III–GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE

3.1 GEOSYNTHETIC CLAY LINER MANUFACTURE AND DELIVERY

3.1.1 Labeling

The CQA representative will verify and document that the GCL manufacturer has labeled each roll of GCL and includes the information required by the technical specifications. The CQA representative will examine GCL rolls upon delivery and deviation from the above requirements will be reported to the CQA certifying engineer prior to installation of the GCL.

3.1.2 Transportation and Handling

The CQA representative will observe and document that the type of GCL handling equipment used by the installer minimizes damage to the material. Upon delivery at the site, the CQA representative will conduct a visual inspection of all rolls for defects and for damage. This examination will be conducted without unrolling rolls unless visible defects or damages are found. The CQA representative will indicate to the CQA certifying engineer:

- Any rolls that need to be unrolled to allow for their inspection
- Any rolls, or portions thereof, that need to be rejected and removed from the site because they have severe flaws
- Any rolls that include minor repairable flaws

3.1.3 Storage

The CQA representative will verify and document that storage of the GCL is in accordance with the technical specifications.

3.1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried. The inventory will include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information, supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative. As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill of Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation
- **Material Type**–Indicate type of geosynthetic material
- **Roll Number**–Indicate each roll number that is written on the roll (The roll numbers contain a variety of information regarding the material and the manufacturing process.)
- **Lot Number**–Lot number
- **Roll (L × W)**–Indicate the roll width as written on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

The CQA representative will immediately notify the IDF CM if a nonconforming or conditional use tag is attached to any of the inventoried items.

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items, to the extent possible. The CQA representative will be responsible for coordinating with the construction general contractor during material delivery, so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives on the site to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill and that all inventories and inspections are documented and maintained.

3.1.5 Quality Assurance Conformance Testing

Either at the manufacturer's plant or upon delivery of the rolls of GCL, the CQA representative will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing, to verify and document conformance with the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet along the length of the roll. Unless otherwise specified, samples will be 1.5 feet (minimum) long by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50,000 square feet, whichever is greater. These samples will be tested for:

- Index Flux (ASTM D5887)
- Bentonite Mass per Unit Area (ASTM D5993)
- Bentonite Swell Index Test (ASTM D5890)

The test will be conducted in accordance with the test procedure presented in the technical specifications.

The CQA representative will examine all results from laboratory conformance testing and compare the results to the specifications presented in the technical specifications. In addition, the CQA representative will report any non-conformance to the CQA certifying engineer as soon as practical after the test results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction general contractor will be required to replace the roll (or rolls) of GCL not in conformance with the specifications with a roll that meets the requirements of the technical specifications.
- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fails to meet the requirements, samples will be collected from the five numerically closest untested rolls on both sides of the failed samples and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of GCL onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The costs of all such tests are to be borne by the construction general contractor.
- The CQA representative will document actions taken in conjunction with conformance test failures as outlined in Section 8.1.4 and report all actions to the CQA certifying officer.

3.2 GEOSYNTHETIC CLAY LINER INSTALLATION

3.2.1 Surface Preparation

For fill surfaces that will underlay a GCL layer, the CQA representative will verify and document the following:

- The surface of the fill does not contain holes, ruts, protrusions, or other surface irregularities in excess of those dimensions specified by the technical specifications.
- The surface of the fill has been compacted to form a firm, stable base.

- The surface of the fill is free of any type of deleterious material that may cause damage to GCL, including debris, organic material, frozen soil, ice, and rocks.
- The surface of the fill is free of standing water or excessive moisture.
- The construction general contractor has certified in writing that the surface on which the GCL will be installed is acceptable.

The subgrade surface will be inspected immediately prior to commencement of GCL installation. If any change in the surface requires repair work, in accordance with the technical specifications, the construction general contractor will be responsible for repairing the fill surface.

A certificate of subgrade surface acceptance will be required from the construction general contractor. The CQA representative will verify that the subgrade is accepted by the GCL installer, immediately prior to commencement of GCL installation.

After the surface on which the GCL is to be installed has been accepted by the construction general contractor, it will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

3.2.2 Anchor Trenches and Sumps

Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify and document the following:

- The sumps and anchor trenches are excavated to the grades and dimensions shown in the construction drawings. Any anomalies in the soil encountered during excavation will be brought to the attention of the IDF project engineer and removed as directed.
- The anchor trench excavation surface is prepared for installation of geosynthetics, with rounded corners, and free of loose soil or deleterious material.

After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify and document that the backfill for the geosynthetic anchor trenches is placed and compacted in accordance with the technical specifications.

3.2.3 Geosynthetic Clay Liner Deployment

3.2.3.1 Field Panel Identification

A field panel is the unit area of GCL that is to be placed in the field (i.e., a field panel is a roll or a portion of roll cut in the field).

The CQA representative will track the placement location of each GCL panel by assigning an identification code (number or letter-number) or by an equivalent tracking method. The identification method will be agreed upon by the CQA certifying engineer and the construction general contractor. This field panel identification scheme will be as simple and logical as possible. (Note: manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the construction general contractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA representative will establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all CQA records.

3.2.3.2 Field Panel Placement

Installation Schedule
The CQA representative will evaluate significant changes in the schedule, proposed by the construction general contractor, and will advise the CQA certifying engineer on the acceptability of that change. The CQA representative will verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the construction general contractor, in accordance with the technical specifications.

Weather Conditions
The CQA representative will verify and document that GCL is not placed during inclement weather conditions, as specified in the technical specifications. Additionally, the CQA monitor will verify and document that the existing underlying layer has not been damaged by weather conditions.

Damage
The CQA representative will visually observe each panel, after placement, for damage. The CQA representative will inform the construction general contractor which panels, or portions of panels, are rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by the CQA representative will be marked, and their removal from the work area will be documented by the CQA representative.

Seam Overlap and Bentonite Seal
The construction general contractor will observe and document that the seam overlaps and bentonite material placed between panels, if required, along the seams meets specification guidelines. The CQA representative will verify overlap width and will observe bentonite seal placement.

3.2.3.3 Field Panel Protection

The CQA representative will observe and document that the GCL is completely covered with geomembrane or protective plastic cover at the end of each workday and protected from damage and hydration due to weather. The CQA representative will verify and document that equipment does not operate directly on the GCL and that a smooth rub sheet is used to maneuver textured geomembrane over the GCL to prevent damage to the GCL.

3.2.4 Defects and Repairs

Any defects and subsequent repairs will be documented, using NCR procedures outlined in Section 8.1.4.

3.2.4.1 Identification

All seams and non-seam areas of the GCL will be inspected by the CQA representative for evidence of defects, holes, contamination of geotextiles, displaced panels, premature hydration, and any sign of contamination by foreign matter. The CQA representative will observe and document repair procedures described below.

3.2.4.2 Repair Procedures

Prior to cover material placement, damage to the GCL will be identified and repaired by the installer.

Rip and Tear Repair (Flat Surfaces)
Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place), with a minimum overlap of 12 inches on all edges.

Accessory bentonite will be placed between the patch edges and the repaired material at a rate of a quarter pound per lineal foot of edge, spread in a continuous 6 inch fillet.

Rip and Tear Repair (Slopes)
Damaged GCL material on slopes will be repaired by the same procedures as described above, however, the overlapped edges of the patch need to be wide enough to ensure the patch will keep its position during backfill or cover operations.

Displaced Panels
Displaced panels will be adjusted to the correct position and orientation. The adjusted panel will then be inspected for any geotextile damage or bentonite loss. Damage will be repaired by the above described procedure.

Premature Hydration
If the GCL is subjected to premature hydration, the construction general contractor will notify the CQA certifying engineer for a site-specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design dependent upon the degree of damage.

SECTION IV–GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

4.1 GEOMEMBRANE MATERIAL

4.1.1 Labeling

The CQA representative will verify and document that the geomembrane manufacturer has labeled each roll of geomembrane and includes the information required by the technical specifications. The CQA representative will examine geomembrane rolls upon delivery and deviation from the requirements will be reported to the CQA certifying engineer, prior to installation of the geomembrane.

4.1.2 Transportation and Handling

Upon delivery at the site, the CQA representative will conduct a visual inspection of all rolls for defects and damage. This examination will be conducted without unrolling rolls unless visible defects or damage are found. The CQA representative will indicate the following to the CQA certifying engineer:

- Any rolls that need to be unrolled to allow for their inspection
- Any rolls, or portions thereof, that need to be rejected and removed from the site because they have severe flaws
- Any rolls that include minor repairable flaws

4.1.3 Storage

The CQA representative will verify and document that storage of the geomembrane is in accordance with the technical specifications.

4.1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried in accordance with the technical specifications. The inventory will include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative. As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation
- **Material Type**–Indicate type of geosynthetic material (HDPE, geotextile, or geonet)
- **Roll Number**–Indicate each roll number that is indicated on the roll (The roll numbers contain a variety of information regarding the material and the manufacture process.)
- **Lot Number**–Lot number as indicated
- **Roll (L × W)**–Indicate the roll width as indicated on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items to the extent possible. The CQA representative will be responsible for coordinating with the construction general contractor during material delivery, so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill, and that all inventories and inspections are documented and maintained.

4.1.5 Quality Assurance Conformance Testing

Either at the manufacturer's plant or upon delivery of the rolls of geomembrane, the CQA representative will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the technical specifications.

Conformance samples will be taken by the CQA representative across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet (minimum) long by the roll width. The CQA representative will mark the direction of the machine used to cut the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50,000 square feet, whichever is greater. These samples will be tested for:

- Thickness (ASTM D5199 or D5994)
- Tensile characteristics (yield strength and elongation at yield, ASTM D638)
- Asperity (GRI GM-12)
- Puncture resistance (ASTM D4833)

Test will be conducted in accordance with the test procedure presented in the technical specifications. The CQA representative will examine all results from laboratory conformance testing and will report any non-conformance after the test results become available. The following procedure will apply whenever a sample fails a conformance test that is conducted by the CQA representative:

- The construction general contractor will be required to replace the roll (or rolls) of geomembrane in non-conformance with the technical specifications with a roll that meets the technical specifications.

- The CQA certifying engineer will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fail, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geomembrane onsite and every roll subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The costs of all such tests are to be borne by the construction general contractor.

4.1.6 Manufacturing Plant Site Visit

The manufacturer shall allow the CQA certifying engineer or his designated representative to visit the manufacturing plant, if the CQA certifying engineer so chooses. If possible, the visit shall be prior to or during the manufacturing of the geomembrane rolls for the specific project. The CQA Engineer or his designated representative shall review the manufacturing process, quality control, laboratory facilities, and testing procedures as described in the technical specifications (see Section 02661).

4.2 GEOMEMBRANE INSTALLATION

4.2.1 Surface Preparation

For SBL surfaces that will underlay a geomembrane layer, the CQA representative will verify and document the following:

- The surface of the subgrade or SBL does not contain holes, depressions, or protrusions in excess of those dimensions specified by the technical specifications.
- The surface of the subgrade or SBL has been rolled with a smooth-drum roller to form a firm stable base without ridges, wheel ruts, and surface irregularities.
- The surface of the subgrade or SBL is free of any type of deleterious material that may cause damage to geomembrane.
- The construction general contractor has certified in writing that the surface on which the geomembrane will be installed is acceptable.

The subgrade and SBL surface will be inspected immediately prior to commencement of geomembrane installation. If any change in the surface requires repair work, in accordance with the technical specifications, the construction general contractor will be responsible for repairing the surface. A certificate of subgrade surface acceptance will be required from the construction general contractor. The CQA representative will verify that the subgrade is accepted by the geomembrane installer immediately prior to commencement of geomembrane installation.

After the surface on which the geomembrane is to be installed has been accepted by the construction general contractor, it will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

4.2.2 Anchor Trenches and Sumps

Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify and document the following:

- The excavation of the sumps and anchor trenches is performed in accordance with the technical specifications. Any anomalies in the soil encountered during excavation will be brought to the attention of the IDF project engineer and removed as directed.
- The anchor trench excavation surface is prepared for installation of geosynthetics with rounded corners and is free of loose soil or deleterious material.

After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify and document that the backfill for the geosynthetic anchor trenches is placed and compacted in accordance with the technical specifications and construction drawings.

4.2.3 Geomembrane Deployment

4.2.3.1 Layout Drawing

The construction general contractor will be required to produce layout drawings that show the geomembrane panel configuration, dimensions, details, and seam locations. The layout drawings must be approved by the CQA certifying engineer, prior to the installation of the geomembrane.

4.2.3.2 Field Panel Identification

A field panel is the unit area of geomembrane that is to be seamed in the field (i.e., a field panel is a roll or a portion of roll cut in the field).

The CQA representative will verify that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code will be agreed upon by the CQA representative and the construction general contractor. This field panel identification code will be as simple and logical as possible. (Note: manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the construction general contractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA representative will establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all CQA records.

4.2.3.3 Field Panel Placement

Location

The CQA representative will verify and document that field panels are installed at the locations and positions indicated in the construction general contractor's layout plan, as approved or modified by the CQA certifying engineer.

Installation Schedule

The CQA representative will evaluate significant changes in the schedule, proposed by the construction general contractor, and will advise the CQA certifying engineer on the acceptability of that change. The CQA representative will verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the construction general contractor in accordance with the technical specifications.

The CQA representative will record the identification code, location, and date of installation of each field panel.

Weather Conditions

The CQA representative will verify and document that geomembrane is not placed during inclement weather conditions, as specified in the technical specifications. Additionally, the CQA representative will verify and document that the underlying layer has not been damaged by weather conditions.

Damage

The CQA representatives will visually observe each panel, after placement and prior to seaming, for damage (e.g., holes, blisters, and creases). The CQA representative will inform the construction general contractor which panels, or portions of panels, need to be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by the CQA certifying engineer will be marked, and their removal from the work area will be documented by the CQA representative, using the NCR procedures outlined in Section 8.1.4.

4.2.4 Field Seaming

4.2.4.1 Seam Layout

The CQA certifying engineer will verify and document that the seam layout shown in the panel layout drawing is consistent with the technical specifications. A seam numbering system compatible with the panel numbering system will be agreed upon by the construction general contractor and CQA certifying engineer.

4.2.4.2 Seaming Equipment and Products

Processes approved by the technical specifications for field seaming are extrusion seaming; and fusion seaming. Proposed alternate processes will be required to be documented and submitted to the CQA certifying engineer for approval. The construction general contractor will be required to use a pyrometer to ensure that accurate temperatures of the extrudate and seamer nozzle are being achieved.

The extrusion seaming apparatus will be equipped with gauges, indicating the temperatures of the extrudate and nozzle. The construction general contractor will be required to provide to the CQA certifying engineer the manufacturer's certification that the extrudate is compatible with the geomembrane material and is comprised of the same resin as the geomembrane.

The CQA representative will log ambient temperatures, seaming apparatus temperatures, and extrudate temperatures or fusion seaming apparatus speeds. Ambient temperatures will be measured to verify compliance with the technical specifications.

4.2.4.3 Seam Preparation

The CQA certifying engineer will verify and document the following:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material.
- Preparation of seams is in accordance with the technical specifications.

4.2.4.4 Weather Conditions for Seaming

The CQA representative will verify and document that weather conditions for seaming are within the limits specified in the technical specifications.

4.2.4.5 Trial Seams

The construction general contractor will be required to make trial seams on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. The construction general contractor will be required to make and test trial seams at the frequency and in accordance with the methods specified in the technical specifications.

The CQA representative will observe all trial seam procedures. The trial seam samples will be assigned a number and marked accordingly by the CQA representative, along with the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. A sample of the trial seam will be retained by the CQA team until the construction of the liner is complete and the liner has been accepted by the CQA certifying engineer.

4.2.4.6 Nondestructive Seam Continuity Testing

Except as otherwise noted in the technical specifications, the construction general contractor will nondestructively test all field seams over their full length, in accordance with the technical specifications. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing will be carried out as the seaming work progresses, not at the completion of all field seaming. Nondestructive testing will not be permitted before sunrise or after sunset unless the construction general contractor demonstrates to the CQA certifying engineer that the construction general contractor has the capabilities to perform continuity testing under reduced light conditions. The CQA representative will perform the following tasks:

- Observe the continuity testing
- Record location, date, test unit number, name of tester, and outcome of all testing
- Document and inform the construction general contractor of any required repairs

The construction general contractor will be required to complete any required repairs, in accordance with the technical specifications. The CQA representative will perform the following tasks:

- Observe the repair and re-testing of the repair
- Mark on the geomembrane that the repair has been made
- Document the results

The CQA representative will verify and document the procedures specified in the technical specifications where seams cannot be nondestructively tested. The location, date of visual observation, name of tester, and outcome of the test or observation will be recorded by the CQA representative and reported to the CQA certifying engineer.

4.2.4.7 Destructive Seam Testing

Concept

Destructive seam tests will be performed at selected locations. The purpose of these tests is to evaluate seam strength and integrity. Seam strength testing will be done as the seaming work progresses, not at the completion of all field seaming.

Location and Frequency

The CQA representative will select locations where seam samples will be cut out for laboratory testing at the frequency specified in the technical specifications (see Section 02661). In general, destructive tests will be located in non-critical areas, such as seam run-out areas or near three-panel intersections or other areas that will require a patch anyway. In addition, because extrusion welding may be limited on a daily basis, extrusion destructive samples may be welded after passing a trial seam on scrap material not used for construction. However, when significant lengths (greater than 100 feet) of seams or caps are extrusion welded, a destructive test of the weld will be taken.

Control charts will be used to track the performance of each welding machine and technician to allow for biased sampling, according to performance. An upper control limit (UCL) will be established to statistically identify the sources of test failures. Machines and technicians whose failure rates exceed the UCL will then be identified and destructively tested at twice the original frequency (one per 250 feet of seam length) to better monitor their performance. Once the failure rate drops back into compliance with the UCL, the original testing frequency will be reinstated. Machines and technicians whose failure notes are below the UCL will be identified to decrease the original frequency, as approved by the CQA certifying engineer.

The UCL is established based on the failure rate for all destructive tests plus three standard deviations with a ceiling of 3.5 percent. The ceiling is the maximum failure rate determined to be acceptable, as agreed upon jointly by the construction general contractor and CQA certifying engineer. The initial UCL will be calculated once a single machine or technician fails two destructive tests and will typically be updated daily with the most recent destructive testing results. Destructive tests tracking a failed destructive will not be included in the calculation of the failure rates.

Additional destructive test locations may be required during seaming operations. The necessity for such additional sampling and testing will be determined by CQA representatives and will be implemented when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other reason to suspect potentially defective seams. The location selection of the additional testing will be based on the CQA representative's judgment and observation of a suspected problem.

The construction general contractor will not be informed in advance of the locations where the seam samples will be taken.

Sampling Procedure

The construction general contractor will be required to cut samples, as directed by the CQA representative as the seaming progresses, in order to have laboratory test results before the geomembrane is covered by another material. The CQA representative will perform the following tasks:

- Observe sample cutting
- Assign a number to each sample and mark it accordingly
- Record the sample number and location on the panel layout drawing
- Record the reason for taking the sample at this location (e.g., routine testing, suspicious feature of the geomembrane)

All holes in the geomembrane resulting from destructive seam sampling will be covered by the construction general contractor immediately after sampling and will be repaired in accordance with the repair procedures described in the technical specifications. The continuity of the new seams in the repaired area will be nondestructively tested, according to the technical specifications.

Size of Samples

At a given sampling location, two types of samples will be taken by the construction general contractor. First, two specimens for field testing will be taken. Each of these specimens will be 1 inch wide by 6 to 12 inches long, with the seam centered parallel to the width. The distance between these two specimens will be approximately 42 inches. If both specimens pass the field test described in the technical specifications, a sample for laboratory testing will be taken.

The sample for laboratory testing will be required to be taken between the two specimens for field testing. The destructive sample will be 12 inches wide by 42 inches long, with the seam centered lengthwise. The sample will be cut into three parts and distributed as follows:

- One portion to the construction general contractor, 12 inches long
- One portion to the IDF CM for archive storage, 12 inches long
- One portion to the CQA certifying engineer for CQA Laboratory testing, 18 inches long

Final determination of the sample sizes will be made at the preconstruction meeting.

Field Testing

The two 1-inch-wide specimens, as specified above, will be required to be tested in the field by the CQA representative by tensiometer for peel and shear and need to not fail in the seam. If any field test sample fails to pass, the procedures outlined in the technical specifications will be followed.

The CQA representative will mark all samples and portions with their number, date, and time.

Geosynthetic Construction Quality Assurance Laboratory Testing

Laboratory destructive test samples will be packaged and shipped to the Geosynthetics CQA Laboratory by the CQA representative in a manner that will not damage the test sample. The CQA representative will store the archive samples until the completion of the project.

Testing will include "Shear Strength" and "Peel Strength" (ASTM D6392) with 1-inch-wide strip, tested at 2 inches per minute. The minimum acceptable values to be obtained in these tests are those indicated in the technical specifications. At least five specimens will be tested for each test method. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear). At least four out of five of the specimens for each test must pass.

The laboratory will provide test results verbally to the CQA certifying engineer in a timely manner after they receive and test the samples. The CQA certifying engineer will review laboratory test results as soon as they become available and will inform the CQA certifying engineer of the test results.

Procedures for Destructive Test Failure

The procedures specified in the technical specifications will be required whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory or by field tensiometer. The CQA certifying engineer will verify and document that one of the options specified in the technical specifications is followed. The CQA representative will document all actions taken in conjunction with destructive test failures, including preparation of NCRs, as outlined in Section 8.1.4.

4.2.5 Defects and Repairs

4.2.5.1 Identification

All seams and non-seam areas of the geomembrane will be inspected by the CQA representative for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be required to be clean at the time of examination. The geomembrane surface will be required to be swept or washed by the construction general contractor if the amount of dust or mud inhibits examination.

4.2.5.2 Evaluation

Each suspect location both in seam and non-seam areas will be required to be either non-destructively tested using the methods described in the technical specifications, or repaired as appropriate as determined by the CQA certifying engineer. Each location that fails the non-destructive testing will be marked by the CQA representative and will be required to be repaired by the construction general contractor. Materials will not be placed over geomembrane locations that have been repaired until the CQA representative has approved the repair.

4.2.5.3 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA representative will visually inspect the geomembrane for wrinkles. Based on the requirements of the technical specifications, the CQA representative will indicate to the construction general contractor which wrinkles, if any, are to be cut, overlapped, and seamed to remove the wrinkle. The seam thus produced will be tested like any other seam.

4.2.5.4 Repair Procedures

Any portion of the geomembrane either exhibiting a flaw or failing a destructive or nondestructive test will be repaired by the construction general contractor in accordance with the applicable method specified in the technical specifications. An NCR will be prepared to document all flaws and failed tests, as outlined in Section 8.1.4. Each repair will be located and logged by the CQA representative.

4.2.5.5 Testing of Repairs

Each repair will be non-destructively tested, using the methods described in the technical specifications as appropriate. Repairs that pass the non-destructive test will be considered adequate. Large caps may be of sufficient extent to require destructive testing, at the discretion of the CQA certifying engineer. Failed tests will require the repair to be redone and re-tested until passing test results are obtained. The CQA representative will observe the non-destructive testing of repairs and will document the date of the repair and test outcome.

4.2.6 Appurtenances

The CQA representative will verify and document the following:

- Installation of the geomembrane around, and connection of geomembrane to, appurtenances have been made according to the technical specifications or manufacturer's recommendations.
- Extreme care is taken while seaming around appurtenances, since neither non-destructive nor destructive testing may be feasible in these areas.
- The geomembrane has not been visibly damaged while being connected to appurtenances.

The CQA representative will inform the CQA certifying engineer if the above conditions are not fulfilled.

4.3 GEOMEMBRANE PANEL LAYOUT SURVEY

A survey will be performed by or under the direction of a professional land surveyor registered in the State of Washington. The surveyor will independently survey the elevations and location of each panel intersection and destructive sample. The results of the survey conducted by the surveyor will be compiled in a report signed by the surveyor and the CQA certifying engineer.

The surveyor will be required to survey each geomembrane panel intersection and destructive sample location for the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying engineer by the surveyor. The survey will include enough information to confirm that the geomembrane layout is in accordance with the panel layout and include, but not be limited to, the following information:

- Geomembrane panel intersections
- Destructive sample location and identification
- Edge of geomembrane liner
- Panel identification numbers

Each geomembrane layer will be surveyed including, but not be limited to:

- Secondary leak detection system geomembrane
- Secondary geomembrane
- Primary geomembrane

4.4 LAYER COMPLETION CERTIFICATION

The construction general contractor will be required to notify the CQA representative when an area of geomembrane is complete, prior to constructing the overlying layer. The construction general contractor may place overlying layer after acceptance of geomembrane layer by the CQA Certifying Engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that all CQA tests are complete and all defects have been repaired and tested.

SECTION V–GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE

5.1 GEOTEXTILE MATERIAL AND INSTALLATION

5.1.1 Labeling

The CQA representative will verify and document that the geotextile manufacturer has labeled all rolls of geotextile with the information specified in the technical specifications. The CQA representative will examine rolls upon delivery, and any deviation from the requirements will be reported to the CQA certifying engineer. Geotextile rolls that are not labeled or that have illegible labels will be removed and disposed by the construction general contractor.

5.1.2 Transportation and Handling

The CQA representative will observe rolls of geotextile upon delivery at the site, and any deviation from the transportation and handling requirements specified in the technical specifications will be reported to the CQA certifying engineer. Any damaged rolls will be rejected by the CQA certifying engineer and required to be repaired or replaced by the construction general contractor.

5.1.3 Storage

The CQA representative will verify and document that storage of the geotextile is in accordance with the technical specifications.

5.1.4 Inventory

All geotextile materials that arrive onsite will be inventoried. The inventory will include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information, supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation
- **Material Type**–Indicate type of geosynthetic material
- **Roll Number**–Indicate each roll number that is indicated on the roll
- **Lot Number**–Lot number
- **Roll (L × W)**–Indicate the roll width as indicated on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items to the extent possible. The CQA representative will coordinate with the construction general contractor during material delivery so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill and that all inventories and inspections are documented and maintained.

5.1.5 Conformance Testing

Either at the manufacturer's factory or upon delivery of the geotextile rolls, the CQA representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the requirements of the technical specifications. Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet along the edge of the roll. Unless otherwise specified, samples will be 3 feet (minimum) long by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Samples will be taken at a rate of one per material lot or one per 50,000 square foot, whichever is greater. These samples will be tested for the following:

- Permittivity (ASTM D4491, Type 1 only)
- Grab strength (ASTM D4632)
- Tear strength (ASTM D4533)
- Puncture strength (ASTM D4833)

The CQA representative will examine all results of laboratory conformance testing and report any non-conformance to the CQA certifying engineer as soon as results become available. The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction general contractor will replace the roll (or rolls) of geotextile not in conformance with the specifications with a roll that meets the requirements of the technical specifications.

- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fail to meet the requirements, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geotextile onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The cost of all such tests are to be borne by the construction general contractor.

The CQA representative will document actions taken in conjunction with conformance test failures and report all actions taken to the CQA certifying engineer. Failed tests will be documented using NCR procedures, outlined in Section 8.1.4.

5.1.6 Deployment

The construction general contractor will be required to handle all geotextile material in such a manner as to ensure that it is not damaged in any way.

It will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

The CQA representative will verify and document compliance with the following:

- Just prior to geotextile placement, the layer that underlies the geotextile, if it is a geosynthetic, is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the liner system.

- In the presence of excessive wind, the geotextile is weighted with sandbags (or equivalent weight approved by the CQA representative).
- Geotextile is kept under tension to minimize the presence of wrinkles in the geotextile. If necessary, the geotextile is positioned by hand after being unrolled to minimize wrinkles.
- Geotextile is cut using a geotextile cutter approved by the geotextile manufacturer and the CQA representative. If in place, special care is taken to protect other materials (such as underlying geosynthetics) from damage that could be caused by the cutting of the geotextiles.
- The construction general contractor takes any necessary precautions to prevent damage to the underlying layers during placement of the geotextile.
- During placement of geotextile, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying layers, generate clogging of drains or filters, or hamper subsequent seaming.
- Geotextile is not left exposed for an excess of 14 days after placement, to prevent damage from exposure to ultraviolet radiation (sunlight). If the geotextile is exposed for more than 14 days, a temporary cover may be deployed for the duration of the delay or samples may be submitted to an independent testing laboratory to ensure that detrimental levels of UV degradation have not occurred. Test results shall be submitted to CQA certifying engineer for review and approval. Detrimental level of UV degradation is defined in the technical specifications (see Section 02371).

The CQA representative will document any non compliance with the above requirements and report them to the CQA certifying engineer.

5.1.7 Seams and Overlaps

The CQA representative will verify and document that all geotextile seams are oriented and overlapped, in accordance with the technical specifications. The construction general contractor will be required to pay close attention at seams to ensure that no protective soil layer material could be inadvertently placed beneath the geotextile.

5.1.8 Repair

The CQA representative will verify and document that any holes or tears in the geotextile are repaired, in accordance with the requirements of the technical specifications. The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying engineer.

SECTION VI–COMPOSITE DRAINAGE NET CONSTRUCTION QUALITY ASSURANCE

6.1 COMPOSITE DRAINAGE NET MATERIAL AND INSTALLATION

6.1.1 Labeling

The CQA representative will verify and document that the composite drainage net manufacturer has labeled all rolls of composite drainage net as specified in the technical specifications. The CQA representative will examine rolls upon delivery, and any deviation from the above requirements will be reported to the CQA certifying engineer prior to installation of the composite drainage net.

6.1.2 Transportation and Handling

The CQA representative will observe rolls of composite drainage net upon delivery at the site, and any deviation from the requirements of the technical specifications will be reported to the CQA certifying engineer. Any damaged rolls will be rejected by the CQA representative and be required to be repaired or replaced by the construction general contractor.

6.1.3 Storage

The CQA representative will verify and document that the storage of the composite drainage net is in accordance with the technical specifications.

6.1.4 Inventory

All CDN that arrive onsite will be inventoried. The inventory will record the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer, to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation
- **Material Type**–Indicate type of geosynthetic material (high-density polyethylene, geotextile, or geonet)
- **Roll Number**–Indicate each roll number that is written on the roll
- **Lot Number**–Lot number as indicated
- **Roll (L × W)**–Indicate the roll width as indicated on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items to the extent possible. The CQA representative will coordinate with the construction general contractor during material delivery so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill and that all inventories and inspections are documented and maintained.

6.1.5 Conformance Testing

Either at the manufacturer's plant or upon delivery of the composite drainage net rolls, the CQA representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing, to verify and document conformance with the requirements of the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet long (minimum) by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Samples will be taken at a rate of one per lot or one per 50,000 square feet, except as noted otherwise below, whichever is greater. The geonets will be tested for the following:

- Polymer specific gravity (ASTM D1505)
- Thickness (ASTM D5199)
- Nominal transmissivity (ASTM D4716 – one per production lot)

The composite drainage nets will be tested for the following:

- Adhesion (GRI-GC7 or ASTM D413)
- Transmissivity (ASTM D4716 – one per production lot)

The CQA representative will examine all results from laboratory conformance testing and will report any non-conformance to the CQA certifying engineer as soon as the results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction general contractor will be required to replace the roll (or rolls) of composite drainage net not in conformance with the specifications with a roll that meets the requirements of the technical specifications.
- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fail, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of composite drainage net onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The cost of such tests is to be borne by the construction general contractor.

The CQA representative will document actions taken in conjunction with conformance test failures and report all actions to the CQA certifying engineer. Failed tests will be documented using NCR procedures, outlined in Section 8.1.4.

6.1.6 Deployment

The construction general contractor will be required to handle all composite drainage net in such a manner as to ensure that it is not damaged.

The construction general contractor (responsible for composite drainage net installation) will be required to certify in writing that the surface on which the composite drainage net will be installed is complete and acceptable. A certificate of partial completion will be given by the construction general contractor to the CQA representative, who will then verify to the CQA certifying engineer that the deployment surface is complete, prior to commencement of composite drainage net installation.

After the surface on which the composite drainage net is to be installed has been accepted by the construction general contractor, the CQA representative will have responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

The CQA representative will verify and document compliance with the following:

- Just prior to composite drainage net placement, the layer that will underlie the composite drainage net is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the underlying layers or clog the drainage system.
- In the presence of excessive wind, the composite drainage net is weighted with sandbags (or equivalent weight approved by the CQA certifying engineer).
- Composite drainage net is kept under tension to minimize the presence of wrinkles in the composite drainage net. If necessary, the composite drainage net is positioned by hand after being unrolled, to minimize wrinkles.
- Composite drainage net is cut using a composite drainage net cutter, approved by the composite drainage net manufacturer and the CQA representative. If in place, special care is taken to protect other materials from damage that could be caused by the cutting of the composite drainage net.
- The construction general contractor takes all necessary precautions to prevent damage to the underlying layers during placement of the composite drainage net.
- Composite drainage net is not welded to geomembranes.
- During placement of clean composite drainage net, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.

- A visual examination of the composite drainage net is carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, such as needles, are present.
- Composite drainage net is not left exposed for an excess of 14 days after placement, to prevent damage from exposure to ultraviolet radiation (sunlight).

The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying engineer.

6.1.7 Seams and Overlaps

The components of the composite drainage net (e.g., geotextile-geonet-geotextile) are not bonded together at the ends and edges of the rolls. The CQA representative will document that the composite drainage net is overlapped and secured in accordance with the technical specifications.

6.1.8 Repair

The CQA representative will verify that any holes or tears in the composite drainage net are repaired, in accordance with the technical specifications. The CQA representative will observe any repair, document any noncompliance with the above requirements, and report the noncompliance to the CQA certifying engineer. Repair areas will be documented using NCR procedures, outlined in Section 8.1.4.

SECTION VII–POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

7.1 PIPE AND FITTINGS

The CQA representative will monitor the placement of the LCRS, LDS and SLDS pipe, located on the IDF landfill floor and on the landfill slopes.

7.1.1 Labeling

The CQA representative will verify that the pipe is labeled with the information specified in the technical specifications. Any deviations from the labeling requirements will be reported to the CQA certifying engineer prior to pipe installation.

7.1.2 Transportation and Handling

The CQA representative will verify and document that the pipe and fittings are handled in accordance with the technical specifications. The CQA representative will visually inspect the pipe upon delivery at the site, and any deviations from the requirements of the technical specifications will be reported to the CQA certifying engineer.

7.1.3 Storage

The CQA representative will verify and document that storage of the pipe and fittings is in accordance with the technical specifications.

7.1.4 Inventory

The CQA representative will inventory the polyethylene piping and fitting, delivered to the site that will be installed at the bottom and on the slopes of the landfill. The CQA representative will perform the following tasks:

- Verify the material for conformance with the technical specifications and construction drawings
- Verify slot dimensions for conformance with the technical specifications
- Check the material for damage, mishandling, and adverse exposure

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate from inventoried and approved items, to the extent possible. The CQA representative will be responsible for coordinating with the construction general contractor during material delivery, to limit the material being moved more than necessary after it is unloaded and thereby minimizing damage due to handling.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill, and that all inventories and inspections are documented and maintained.

7.1.5 Conformance Testing

No conformance testing will be conducted on the materials delivered to the site.

7.1.6 Handling and Laying

The CQA representative will verify and document that the pipe is installed at the specified locations, grades, and angles, and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the technical specifications and in a manner intended to prevent damage to the pipe.

The pipe and fittings will be carefully examined before installation by the CQA representative. The CQA representative will verify and document that cracks, damage, or defects are not present in the pipe and fittings in excess of that allowed by the technical specifications.

The CQA representative will also note the condition of the interior of pipes and fittings. Foreign material will be removed from the pipe interior before it is moved into final position. No pipe will be permitted to be placed until the CQA representative has observed the condition of the pipe. The CQA representative will document any deviation from the requirements and report it to the CQA certifying engineer.

7.1.7 Joints and Connections

Lengths of pipe will be required to be assembled into suitable installation lengths by the butt-fusion process. Butt-fusion refers to the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure. The CQA representative will spot-monitor butt-fusion welding operations to ensure that the construction general contractor follows the technical specifications for both slotted and solid pipes. The CQA representative will verify that internal weld beads have been removed from the horizontal and side slope sections of the LCRS, LDS, and SLDS riser pipes. The CQA representative will document any noncompliance with the requirements and report it to the CQA certifying engineer.

7.1.8 Surveying

A survey will be performed by or under the direction of a professional land surveyor registered in the State of Washington. The surveyor will independently survey the final elevation and alignment of the top of the pipe and fittings. Surveys will be performed on all pipe locations within the footprint of the landfill to confirm that the alignment and elevations in the field agree with those shown in the construction drawings. The results of the survey will be compiled in a report signed by the surveyor and the CQA certifying engineer.

The surveyor will be required to survey each pipe location within the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying engineer by the surveyor before placement of the next liner system layer. The surveys will be conducted every 50 feet along the pipe alignment and appurtenances. The survey will include enough information to confirm that the following features of the landfill piping are constructed in accordance with the construction drawings:

- Beginning and end top of pipe elevations
- Connection location
- Grade breaks
- Riser pipes
- Sump extensions

The piping that will be surveyed will include, but not be limited to, the following:

- SLDS piping
- LDS piping
- LCRS piping

The CQA certifying engineer will approve the survey results for each layer before the subsequent component of the lining system is constructed.

SECTION VIII–CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION AND CERTIFICATION

8.1 DOCUMENTATION AND CERTIFICATION

A major function of CQA is to properly and adequately document and certify the work. This section describes the minimum required documentation. The CQA certifying engineer may recommend to the IDF CM additional documentation for performing CQA tasks that are for certification. In addition, the CQA certifying engineer will prepare forms, field data sheets, sample labeling schemes, and chain-of-custody procedures and submit them to the IDF CM and IDF PM for approval, prior to construction.

8.1.1 Daily Reports

Daily reports will be completed by the CQA representatives when they are onsite. All CQA personnel will be assigned field books by the CQA certifying engineer that will be labeled with a unique number. The CQA representatives, including the CQA certifying engineer, will record all field observations and the results of field tests in their assigned field book. When not in use, all field books will be left in the field records file. After each book is filled (or at the end of the project), the field book will be returned to the CQA certifying engineer and routed to the project files.

Each page of the field book will be numbered, dated, and initialed by CQA personnel. At the start of a new work shift, CQA personnel will list the following information at the top of the page:

- Job name
- Job number
- Date
- Name
- Weather conditions
- Page number (if pages are not pre-numbered)

The remaining individual entries will be prefaced by an indication of the time at which they occurred. If the results of test data are being recorded on separate sheets, it will be noted in the field book. Entries in the field book will include, but not be limited to, the following information:

- Reports on any meetings held and their results
- Equipment and personnel being used in each location, including construction general contractors
- Descriptions of areas being observed and documented
- Descriptions of materials delivered to the site, including any quality verification (vendor certification) documentation
- Descriptions of materials incorporated into construction
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration
- Decisions made regarding use of material and/or corrective actions to be taken in instances of substandard quality
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item

At the end of each day, the field CQA monitor will summarize the day's activities on a daily field monitoring report form. The field report will include a brief summary of the day's activities and highlight any unresolved issues that must be addressed by the CQA certifying engineer or by CQA representatives the following day.

The daily field monitoring report will be filled out in triplicate. The CQA monitor will attach three copies of the field book notes for that day. The three copies will be distributed as follows:

- Original will be filed in field office
- One copy will be transmitted to the CQA certifying engineer
- One copy will be transmitted to the IDF CM

The CQA certifying engineer will review and initial each summary field report before distributing to the project quality records and the IDF CM.

8.1.2 Inspection Data Sheets

All observed field and laboratory test data will be recorded on an inspection data sheet. At a minimum, each inspection data sheet will include the following information:

- Unique identifying sheet number for cross-referencing and document control
- Description of the inspection activity
- If appropriate, location of inspection activity or location from which the sample was obtained
- Type of inspection activity and/or procedure used (reference to standard method when appropriate)
- Any recorded observation or test data, with all necessary calculations
- Results of the inspection activity and comparison with specification requirements
- Identification of any personnel involved in the inspection activity
- Signature of the individual(s) performing the CQA representative activity and concurrence by the CQA certifying engineer

- Identification of deficiencies and any required reinspections

Forms used for the data sheets will be prepared and submitted to the IDF CM and IDF PM in accordance with this section. The data sheets will include, but are not limited to, the forms listed below:

- Sample log
- Compaction test result log
- Soil test result summary form
- Equipment calibration log

8.1.3 Record Drawing Maintenance

The construction general contractor will maintain a complete set of construction drawings labeled "Red-Line" as-built drawings. At the completion of the project, the as-built drawings pertaining to the work certified under this CQA Plan will be produced in electronic format and submitted to the CQA certifying engineer. The CQA certifying engineer will review the completed set of as-built drawings and certify the drawing set as the record drawings for the IDF.

8.1.4 Non-Conformance Reporting

Deficiencies/defects identified by in-process testing may be reworked in accordance with the technical specifications or CQA Plan to correct the deficiency without initiating the NCR process (i.e., failed compaction test or failed geomembrane destructive test), and in-process tests will be tracked by the CQA representative until it is corrected. A non-conformance is considered to be a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. All deficiencies, defects, damage, or test failures that are not corrected by in-process rework will be considered a non-conformance and will be documented on a Non-Conformance Report (NCR) form. The non-conformance will be referred to the IDF CM, for disposition and initiation of corrective action processes.

All NCR situations will be brought to the attention of the IDF CM for concurrence, prior to initiating the NCR. Upon issuance of the non-conformance report, the IDF CM will notify the IDF design engineer, IDF quality engineer, and IDF PM that the report has issued. Other individuals, as directed by the IDF PM, will participate in NCR disposition, resolution, and corrective action processes as needed. All documentation relating to NCR situations will be retained in the project quality records.

8.1.5 Resolution of Contract Document Questions and Clarifications

Request for Information (RFI) forms will be provided to the CQA certifying engineer for the purpose of submitting written requests to the IDF CM, for assistance in understanding the design intent of the contract documents. The CM will determine whether the IDF design engineer's technical support staff will address the RFI.

RFIs initiated by the construction general contractor will be addressed by the IDF project engineer and CM, not by the CQA certifying engineer, and are not in the scope of the CQA Plan.

Any RFIs that result in contract document changes will be incorporated by the IDF CM and PM, following the procedures outlined in Section 8.1.6.

8.1.6 Construction Change Order and Contract Document Changes

Requests for changes to the technical specifications or construction drawings will be referred to the IDF CM and initiated as a change order. All change orders and resulting design changes will be approved by the appropriate project team member prior to implementation, as outlined in procedure HNF-IP-0842, Volume 4., Section 4.29 (Engineering Document Change Control Requirements). Requests for modifications to the CQA Plan will also be made by completing a change order to the IDF CM and procurement agent, with copies to the IDF quality engineer and IDF project engineer.

If, during the course of construction, questions arise regarding interpretation of the plans and/or specifications, the IDF CM will be contacted by the CQA certifying engineer. Any clarification of the construction drawings will be documented by a change order, if necessary, or by telephone conversation records or meeting minutes, and routed to the IDF design engineer, IDF CM, and IDF PM. The change order will also be routed to the project files.

8.1.7 Progress Reports

The CQA certifying engineer will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. At a minimum, this report will include the following information:

- A unique identifying sheet number for cross-referencing and document control
- The date, project name, location, and other information
- A summary of work activities accomplished during the progress reporting period
- Identification of areas or items inspected and/or tested during the reporting period that are addressed by the report
- A summary of the quality characteristics being evaluated, with appropriate cross-references to technical specifications and/or construction drawings
- References to the technical specifications or construction drawings defining the acceptance criteria for each inspected characteristic
- A summary of inspection and test results, failures, and re-tests
- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period
- A summary of other problem resolutions and dispositions
- The signature of the CQA certifying engineer

The progress report will be submitted to the IDF PM no more than two days after the last reporting day in the progress report. Copies will also be submitted to the IDF PM, IDF quality engineer, and construction general contractor.

8.1.8 Final Documentation and Certification

All daily inspection summary reports, inspection sheets, problem identification and corrective measures reports, acceptance reports, change orders, NCRs, photographic records, progress reports, construction drawings, construction drawing revisions, and other pertinent documentation will be retained as permanent project quality records. At the completion of the project, a final CQA report that incorporates all such information, along with as-built drawings, will be prepared by the CQA certifying engineer and submitted to the IDF PM. The CQA certifying engineer will prepare an interim report for construction and testing of the test pads. A final CQA report and certification letter will be completed at the end of the construction that will fulfill the CQA certification requirements specified in WAC 173-303-335(4).

The CQA certifying engineer will coordinate the completion of the as-built record drawings that will be generated by a land surveyor licensed in the State of Washington. The as-built records will include scale drawings depicting depths, plan dimensions, elevations, fill thicknesses, and geosynthetic panel layouts. The report will include documentation of each construction component monitored by CQA personnel and will be signed, stamped, and certified by the CQA certifying engineer.

8.1.9 Storage of Records

During the construction of the IDF, the CQA certifying engineer will be responsible for all CQA documents. This includes the CQA certifying engineer's copy of the design criteria, plans, procedures, and specifications; the CQA Plan; and the originals of all the data sheets and reports. The field records will be kept in lockable, metal cabinets or on metal shelving within a facility, protected by a fire alarm and/or a communication system that provides fire department response and/or fire suppression systems; or, in an Underwriters Laboratory-listed, one-hour fire-rated cabinet. At the completion of the project, all completed documents will be routed to the project quality records.

8.1.10 Storage of Archive Construction Material Samples

The CQA certifying engineer will be responsible for storing construction material samples collected during the duration of the project.

The CQA certifying engineer will coordinate with the IDF PM and IDF CM on which samples will be archived at the completion of the project. All samples will be kept in small containers (i.e., 5-gallon plastic buckets). Each container will be labeled with the following information:

- Project name
- Date
- Sample I.D.
- Material type
- Point of contact

Control and protection of samples will be accomplished through the use of an index listing of samples. This index will identify each sample gathered and include the same information required for the sample containers. It will also identify where the sample is stored and person responsible for the sample storage, thus providing a documented record of each sample and methodology for verifying that all samples are available in storage and that no samples have been misplaced.

All samples will be stored neatly in a cool, dry location, approved by the CQA certifying engineer. The CQA certifying engineer will coordinate with the IDF PM and IDF CM to determine which sample will be archived at the project completion.

SECTION IX–REFERENCES

40 CFR 264.19. *Code of Federal Regulations,* Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Section 19, "Construction Quality Assurance Program." Office of the Federal Register. July 9, 1999.

ASTM. *1997 Annual Book of ASTM Standards,* Volume 4.08: Soil and Rock (I). American Society for Testing and Materials, Philadelphia, Pennsylvania. 1997.

CH2M HILL. *Drawings for the Integrated Disposal Facility (IDF) Detailed Design.* RPP-19941, Rev. 0. Prepared for CH2M HILL Hanford Group. February 2004.

CH2M HILL. *Specifications for the Integrated Disposal Facility (IDF) Detailed Design.* RPP-18489, Rev. 0. Prepared for CH2M HILL Hanford Group. February 2004.

Geosynthetic Research Institute (GRI). "Standard Test Method for Asperity Measurement of Textured Geomembranes Using a Depth Gage," Test Method GM12. Philadelphia, Pennsylvania. 2000.

U.S. Department of Energy. "Radioactive Waste Management," DOE O 435.1. August 28, 2001.

U.S. Environmental Protection Agency, Office of Research and Development. *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93-182. Cincinnati, Ohio. 1993.

Washington Administrative Code (WAC) 173-303-335, *Construction Quality Assurance Program.*

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Appendix 4C **Facility Response Action Plan**

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LEAKAGE RESPONSE ACTION PLAN

WAC 173-303-665(9) regulations require the owner of the operator of a landfill unit to have an approved Response Action Plan (RAP) before receipt of waste. The RAP is a site-specific plan that establishes actions to be taken if leakage through the upper (primary) lining system of a landfill exceeds a certain rate. The intent of the RAP is to assure that any leachate that leaks through the primary lining system will not migrate out of the landfill into the environment.

A key element of the RAP is the Action Leakage Rate (ALR), a threshold value which triggers the responses described in the RAP, but below which no special actions are required. Because landfill liner systems have not yet been perfected, a small amount of leakage through the primary liner generally occurs, despite the use of best available materials, construction techniques, and quality assurance procedures. (This leakage is collected by the LDS system and removed from the landfill.) Hence, the ALR is set at some level higher than normally expected leakage rates to serve as an indicator that the primary lining system is not functioning as expected. Exceeding the ALR may reflect serious failure of the primary lining system and indicates the need for investigation and possibly corrective action while the problem is still manageable.

This RAP has been prepared in accordance with requirements of WAC 173-303-665(9). The requirements for determining the ALR are contained in WAC 173-303-665(8) and EPA guidance document, *Action Leakage Rates for Leak Detection Systems* (EPA 530-R-92-004).

The following sections establish the ALR and discuss response actions to be taken if the ALR is exceeded.

Action Leakage Rate

Section 5.11 provides a detailed discussion of the analysis to determine the ALR into the LDS for the IDF. Based on this analyses, the ALR for the IDF permitted cell is 206 gallons per acre per day, or approximately 1,800 gallons per day per cell (each cell area is approximately 8.5 acres). This value includes a factor of safety of 2 in accordance with EPA guidelines (57 FR 19). It is also much lower than the LDS pump capacity. Details of the calculation are presented in Appendix C.10.

In accordance with WAC 173-303-665(8)(b), the flow rate used to determine if the ALR has been exceeded will be calculated as the average daily flow rate into the sump, expressed as gallons per acre per day (unless Ecology approves a different calculation). This calculation will be performed on a weekly basis during the active (operational) life of the landfill, and monthly after the landfill has been closed. Post-closure frequency may be reduced if only minimal amounts of leachate accumulate in the leak detection system sump. As outlined in WAC 173-303-665(4)(c)(ii), during post-closure monitoring, if the liquid level in the LDS sump stays below the pump operating level for two consecutive months, monitoring of the amount of liquid in the LDS sumps can be reduced to at least quarterly. If the liquid level in the LDS sump stays below the pump operating level for two consecutive quarters, monitoring of the amount of liquid in the LDS sumps can be reduced to at least semiannually. Pump operating level is defined as a liquid level approved by Ecology, based on pump activation level, sump dimensions, and level that minimizes head in the sump.

Response Actions

WAC 173-303-665(9) lists several required actions if the ALR is exceeded. In the event that the ALR is exceeded, DOE will:

- Notify Ecology in writing of the exceedance within 7 days of the determination
- Submit a preliminary written assessment to Ecology within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, cause of any leaks, and short-term actions taken and planned
- Determine, to the extent practicable, the location, size , and cause of any leak
- Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed
- Determine any other short-term and longer-term actions to be taken to mitigate or stop any leaks
- Within 30 days after the notification that the action leakage rate has been exceeded, submit to Ecology the results of the analyses specified in bullets 3, 4, and 5 of this section, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, the owner or operator must submit to the regional administrator a report summarizing the results of any remedial actions taken and actions planned.

If the ALR is exceeded, the DOE will submit the required notifications to Ecology, as stated above. The EPA will also receive copies of this confirmation.

The leachate will be analyzed for RCRA constituents. If the analytical results indicate that these constituents are present, and if the constituents can be traced to a particular type of waste stored in a known area of the landfill, then it may be possible to estimate the location of the leak. However, because the waste will meet land disposal restrictions, it will contain no free liquids and will be stabilized or solidified, except as allowed by Appendix 3A, section 1.2. In addition, the canister(s) or other type of waste package(s) may not undergo enough deterioration during the active life of the landfill to permit escape of its contents. For these reasons, it is possible that the leachate may be clean or the composition too general to indicate a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this procedure risks damaging the liner. In addition, waste would have to be handled, stored, and replaced in the landfill. Backfill would need to be removed from around the waste packages to accomplish this. If the waste packages are damaged during this process, the risk of accidental release may be high. For these reasons, large scale removal of waste and liner system materials is not considered a desirable option and will not be implemented except as a last resort.

The preferred options for remediation include covers and changes in landfill operating procedures. The preferred alternative will depend on factors such as the amount of waste already in the landfill, the rate of waste receipt, the chemistry of the leachate, the availability of other RCRA-compliant disposal facilities, and similar considerations. Hence, at this time no single approach can be selected. If the ALR is exceeded, potential options will be evaluated prior to selecting a remediation process. If necessary, an interim solution will be implemented while the evaluation and permanent remediation is performed. Examples of potential approaches include the following:

- The surface of the intermediate soil cover over the waste could be graded to direct runoff into a shallow pond. The surface would then be covered with a discardable, temporary geomembrane (e.g., 30-mil PVC or reinforced polypropylene). Precipitation water would be pumped or evaporated from the pond and would not infiltrate the waste already in the landfill. Waste packages would be placed only during periods of dry weather and stored temporarily at other times. This type of approach would also be used, if necessary, to reduce leakage during the time immediately after the ALR was exceeded, while other remediation options were being evaluated.

- If the landfill was nearly full, partial construction of the final closure cover might be an option. This would reduce infiltration into the landfill and possibly the leakage rate, if the cover was constructed over the failed area.
- A layer of low-permeability soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second "primary" liner higher in the landfill. This new liner would intercept precipitation and allow its removal.
- A rigid-frame or air-supported structure could be constructed over the landfill to ensure that no infiltration occurred. Although costly, this approach might be less expensive than constructing a new landfill.

In general, the selected remediation efforts would be those that are easiest to implement, with more difficult or expensive options to be applied only if earlier approaches were not satisfactory.

REFERENCES

EPA 530-R-92-004, *Action Leakage Rates for Leak Detection Systems*, U.S. Environmental Protection Agency, Office of Solid Waste Management, Washington, D.C., January 29, 1992.

57 FR 19, *Liners and Leak Detection Systems for Hazardous Waste Land Disposal Units*, U.S. Environmental Protection Agency, January 1992.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

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Integrated Disposal Facility

Chapter 5.0 Groundwater Monitoring for Land Based Units

Figures

Tables

5.0 GROUNDWATER MONITORING FOR LAND BASED UNITS [D-10]

The IDF will be a RCRA-compliant landfill (i.e., a double-lined trench with leachate collection system). This chapter describes the groundwater monitoring plan for the IDF and addresses the requirements of RCRA, as described in 40 CFR 264, Subpart F, by reference of WAC 173-303-645(3). Figure 5-1 shows the location of the IDF and surrounding groundwater wells in the 200 East Area. This chapter is designed to meet final status detection-level groundwater monitoring requirements for the IDF. This groundwater monitoring plan is based on the application of a modified data quality objectives (EPA QA/G-4) process to a conceptual model, and the most recent evaluations of groundwater hydrology and chemistry at the site.

This plan describes the characteristics of the waste to be disposed in the IDF and the site geology and hydrology used to design and operate the monitoring well network and to interpret the groundwater data. The historic groundwater chemistry from wells near the IDF site is provided. Much of the information pertaining to waste characterization is taken from HNF-4921 and that pertaining to hydrogeology from PNNL-11957, PNNL-12257, PNNL-13652, and PNNL-14029.

The plan includes a description of network well locations, well construction, sample constituents, and sampling frequency for detection-level groundwater monitoring. Procedures for determination of compliance point groundwater quality also are included. Finally, this plan provides the basis for rapid development of a compliance-monitoring plan if a validated exceedance of an indicator parameter is found. This plan controls initial baseline monitoring and subsequent detection level monitoring only for the IDF.

Source, special nuclear, and byproduct materials as defined by the *Atomic Energy Act of 1954*, as amended, are regulated at DOE facilities exclusively by DOE acting pursuant to its AEA authority. These materials are not subject to regulation by the State of Washington. All information contained herein and related to, or describing AEA-regulated materials and processes in any manner, may not be used to create conditions or other restrictions set forth in any permit, license, order, or any other enforceable instrument. DOE asserts that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear and by-product materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

5.1 EXEMPTION FROM GROUNDWATER PROTECTION REQUIREMENT [D-10a]

An exemption is not requested.

5.2 INTERIM STATUS PERIOD GROUNDWATER MONITORING DATA [D-10b]

The IDF will be a new facility constructed in the 200 East Area. Interim status groundwater monitoring is not applicable.

5.3 AQUIFER IDENTIFICATION [D-10c]

The following sections discuss geology and hydrology.

5.3.1 Geology of the IDF Site

The 200 East Area lies on the Cold Creek bar, a geomorphic remnant of the cataclysmic, glacial related floods of the Pleistocene Epoch. As the floodwaters raced across the lowlands of the Pasco Basin and Hanford Site, floodwaters lost energy and began to deposit sand and gravel. The 200 Area Plateau is one of the most prominent deposits. The 200 Area Plateau lies just southwest of one of the major flood channels across the Hanford Site that forms the topographic lowland south of Gable Mountain.

Borehole data provide the principal source of geologic, hydrologic, and groundwater information for the 200 East Area and the IDF site. Numerous boreholes (both vadose zone boreholes and groundwater monitoring wells) have been drilled in the 200 East Area for groundwater monitoring and waste management studies (Figure 5-1 shows the location of groundwater wells near the IDF site.) However, data are limited within the IDF site primarily because no previous construction or waste disposal activities have occurred in this part of the Hanford Facility. Most boreholes in the 200 East Area have been drilled using the cable tool method and either a hard tool or drive barrel to advance the hole. Some boreholes have been drilled by rotary and wire-line coring methods. More recently, boreholes in the area have been drilled, and in five cases cored, by percussion hammer methods. Geologic logs are based on examination of drill core, chips, and cuttings from these boreholes. Chip samples typically are taken at 1.5-meter intervals and routinely archived at the Hanford Geotechnical Sample Library.

5.3.1.1 Structural Framework

The IDF site will be located south of the Gable Mountain segment of the Umtanum Ridge anticline and about 3 kilometers north of the axis of the Cold Creek syncline, which controls the structural grain of the basalt bedrock and the Ringold Formation. The basalt surface and Ringold Formation trend roughly southeast-northwest parallel to the major geologic structures of the site. As a result, the Ringold Formation and the underlying Columbia River Basalt Group gently dip to the south off the Umtanum Ridge anticline into the Cold Creek syncline.

Geologic mapping on the Hanford Site and examination of drill core and borehole cuttings in the area have not identified any faults in the vicinity of the IDF site (DOE/RW-0164). The closest known faults are along the Umtanum Ridge-Gable Mountain structure north of the disposal site and the May Junction fault east of the site (Figure 5-2).

5.3.1.2 Stratigraphy

The basalt and post-basalt stratigraphy for the IDF site is shown in Figure 5-3. Approximately 137 to 167 meters of suprabasalt sediments overlie the basalt bedrock at the site.

Basalt Bedrock. Previous studies (RHO-BWI-ST-14; Reidel and Fecht 1994) have shown that the youngest lava flows of the Columbia River Basalt Group at the 200 East Area are those of the 10.5 million-year old Elephant Mountain Member. This member underlies the entire 200 East Area and surrounding area and forms the base of the suprabasalts aquifer. No erosional windows in the basalt are known or suspected to occur in the area of the IDF site.

Ringold Formation. Few boreholes penetrate the entire Ringold Formation at the IDF site so available data are limited. The Ringold Formation reaches a maximum thickness of 95 meters on the west side of the site and thins eastward. The member of Wooded Island (Figure 5-3) is the only member of the Ringold Formation in the 200 East Area. The deepest Ringold Formation unit encountered is the lower gravel, unit A. Lying above unit A is the lower mud unit and overlying the lower mud unit is upper gravel, unit E. The sand and silt units of the members of Taylor Flat and Savage Island of the Ringold Formation are not present at the IDF site. Unit A and unit E are equivalent to the Pliocene-Miocene continental conglomerates (Reidel and Fecht 1994). The lower mud unit is equivalent to the Pliocene-Miocene continental sand, silt, and clay beds (Reidel and Fecht 1994).

Only three boreholes have penetrated unit A in the area of the IDF site. Unit A is 19 meters thick on the west side of the site and thins to the northeast. Unit A is partly to well-cemented conglomerate consisting of both felsic and basaltic clasts in a sandy matrix and is interpreted as a fluvial gravel facies (Lindsey 1996). There are minor beds of yellow to white interbedded sand and silt. Green-colored, reduced-iron stain is present on some grains and pebbles. Although the entire unit appears to be cemented, the zone produced abundant high-quality water in borehole 299-E17-21 (PNNL-11957).

Nineteen meters of the lower mud unit were encountered in one borehole at the IDF site (PNNL-11957). The upper most 1 meter or so consists of a yellow mud to sandy mud. The yellow mud grades downward into about 10 meters of blue mud. The blue mud, in turn, grades down into 7 meters of brown mud with organic rich zones and occasional wood fragments. The lower mud unit is absent in the center of the site (northeast of borehole 299-E24-7 on Figure 5-4).

Unit E is described as a sandy gravel to gravelly sand. Unit E is interpreted to consist of as much as 15 meters of conglomerate with scattered large pebbles and cobbles up to 25 centimeters in size in a sandy matrix. The gravel consists of both felsic and basaltic rocks that are well rounded with a sand matrix supporting the cobbles and pebbles. Cementation of this unit ranges from slight to moderate. The upper contact of unit E is not identified easily at the IDF site. In the western part of the study area, unconsolidated gravels of the Hanford formation directly overly the Ringold Formation unit E gravels, making exact placement of the contact difficult. The dominance of basalt and the absence of cementation in the Hanford formation are the key criteria used to distinguishing these here (PNNL-11957). In the central and northeast part of the area, unit E has been eroded completely. Unconsolidated gravels and sands typical of the Hanford formation replace unit E.

Unconformity at the Top of the Ringold Formation. The surface of the Ringold Formation is irregular in the area of the IDF site. A northwest-southeast trending erosional channel or trough (the Columbia River/Missoula flood channel) is centered through the northeast portion of the site. The trough is deepest near borehole 299-E24-21 in the northern part of the site (PNNL-13652). This trough is interpreted as part of a larger trough under the 200 East Area resulting from scouring by the Missoula floods. Borehole 299-E17-21, located at the southwest corner of the IDF site, is at the west side of the channel where approximately 46 meters of Ringold Formation have been removed and replaced by Hanford formation gravels. Boreholes 299-E17-25 and 299-E17-23, located along the southeastern edge of the Site, are near the deepest portion of the channel where it is interpreted that almost all of the Ringold Formation has been eroded. At this location the water table in the channel is interpreted to be 52 meters above the basalt, which forms the floor of the channel. The surface of basalt rises to the north where the water table is approximately 27 meters above the basalt at the northeast corner of the site near borehole 299-E24-21.

Hanford formation. The Hanford formation is as much as 116 meters thick in and around the IDF site. The Hanford formation thickens in the erosional channel cut into the Ringold Formation and thins to the southwest along the margin of the channel.

At the IDF site, the Hanford formation consists mainly of sand dominated facies with lesser amounts of silt dominated and gravel dominated facies. The Hanford formation has been described as poorly sorted pebble to boulder gravel and fine- to coarse-grained sand, with lesser amounts of interstitial and interbedded silt and clay. In previous studies of the site (WHC-MR-0391), the Hanford formation was described as consisting of three units: an upper and lower gravel facies and a sand facies between the two gravelly units. The upper gravel dominated facies appears to be thin or absent in the immediate area of the IDF site (PNNL-12257, PNNL-13652, and PNNL-14029).

The lowermost part of the Hanford formation encountered in boreholes at the IDF site consists of the gravel dominated facies. Drill core and cuttings from boreholes 299-E17-21, 299-E17-22, 299-E17-23, 299-E17-25, and 299-E24-21 indicate that the unit is a clast-supported pebble- to cobble-gravel with minor amounts of sand in the matrix. The cobbles and pebbles almost are exclusively basalt with no cementation. This unit pinches out west of the IDF site and thickens to the east and northeast (Figure 5-4). The water table beneath the IDF site is located in the lower gravel unit. The lower gravel unit is interpreted to be Missoula flood gravels deposited in the erosional channel carved into the underlying Ringold Formation.

The upper portion of the Hanford formation consists of at least 73 meters of fine- to coarse-grained sand with minor amounts of silt and clay and some gravelly sands.

Holocene Deposits. Holocene, eolian deposits cover the southern part of the IDF site. Caliche coatings on the bottom of pebbles and cobbles in drill cores through this unit are typical of Holocene caliche development in the Columbia Basin. The southern part of the IDF site is capped by a stabilized sand dune. The eolian unit is composed of fine- to coarse-grained sands with abundant silt, as layers and as material mixed with the sand.

Clastic Dikes. A clastic dike was encountered in borehole C3828, adjacent to well 299-E17-25, at the IDF site. Clastic dikes also have been observed in excavations surrounding the site [e.g., US Ecology, the former Grout area, the 216-BC cribs, the Central Landfill, and the Environmental Restoration Disposal Facility (BHI-01103)]. In undisturbed areas, such as the IDF site, clastic dikes typically are not observed because these are covered by wind blown sediments. The occurrence of a clastic dike in borehole C3828 suggests that these probably are present elsewhere in the subsurface at the disposal site. The IDF excavation will be geologically mapped to document the occurrence of any clastic dikes that may exist at the site.

5.3.2 Groundwater Hydrology

The unconfined aquifer under the IDF site occurs in the fluvial gravels of the Ringold Formation and flood deposits of the Hanford formation. The thickness of the aquifer ranges from about 70 meters at the southwest corner of the site to about 30 meters under the northeast corner of the IDF site. The Elephant Mountain Member of the Columbia River Basalt Group forms the base of the unconfined aquifer (Figure 5-4).

The unsaturated zone beneath the land surface at the IDF site is approximately 100 meters thick and consists of the Hanford formation. The water level in boreholes in and around the site indicates that the water table is in the lower gravel sequence of the Hanford formation and at an elevation of approximately 123 meters above sea level. The water table is nearly flat beneath the IDF site. Table 5-1 gives water level information from wells near the site. The locations of the wells are shown on Figure 5-1. The latest water table map shows less than about 0.1 meter of hydraulic head differential across the IDF site (Figure 5-5).

The Ringold Formation lower mud unit occurs within the aquifer at the southwest corner of the IDF site (299-E17-21) but is absent in the central and northern parts of the site (299-E24-7 and 299-E24-21). The lower mud unit is known to be a confining or partly confining layer at places under the Hanford Site (PNNL-12261) and this might be the case under the southwest corner of the IDF site. Groundwater samples were collected and analyzed from above and below the lower mud unit during drilling of well 299-E17-21. Chemical parameters (pH, electrical conductivity, and Eh) were different in the two samples suggesting that the lower mud is at least partly confining in the area. No contamination was found above or below the lower mud. An interpretation of the distribution and thickness of this stratum is shown in Figure 5-4. The surface of the lower mud unit is interpreted to dip gently to the southwest (PNNL-13652).

Hydrographs for selected wells near the IDF site are shown in Figure 5-6. Although the water table is extremely flat in the area of the IDF, hydrographs suggest that groundwater flow has had an easterly component throughout the 1990s and has not significantly changed due to cessation of discharges to the 216 B pond system. Hydrographs for the older wells (299-E23-1, 299-E23-2, and 299-E24-7) show two maxima in the water level. These coincide with the operation of the PUREX Plant, which operated between 1956 and 1972 and between 1983 and 1988. All the hydrographs show a decline in the water table during recent years. The rate of decline is between 0.18 and 0.22 meter per year and will take between 10 and 30 years to stabilize. The reason for the decline is the cessation of effluent discharge to the 216-B Pond System, which is centered northeast of 200 East Area. Based on hindcast water table maps (BNWL-B-360), the water table is expected to decline another 2 to 7 meters before reaching pre-Hanford Site elevations. The cessations of effluent discharge also are responsible for changes in the direction of groundwater flow across much of the 200 East Area.

Groundwater flow beneath the IDF site recently was modeled to be southeasterly (PNNL-13400). This direction differs from the easterly direction predicted by the analysis of WHC-SD-WM-RPT-241 and other earlier reports. The southeasterly flow direction primarily is attributable to inclusion of the highly permeable Hanford formation sediments in the ancestral Columbia River/Missoula flood channel in the analysis. A southeasterly flow direction is reflected in the geographic distribution of the regional nitrate plume and in the distribution of other constituents under the south-central 200 East Area (PNNL-14187). As stated in PNNL-13404, the water table gradient is too low to be used for determining flow direction or flow rate at the PUREX Plant cribs immediately east of the IDF site.

Hydraulic conductivity directly beneath the IDF site was estimated from data collected during four slug tests at well 299-E17-21 and five slug tests of 299-E24-21. The interval tested at 299-E17-21 was the upper 7.8 m of the unconfined aquifer from 101.3 to 109.1 m depth. That portion of the aquifer is Hanford formation gravel from 101.3 to 102.1 m depth and Ringold Formation unit E gravels from 102.1 to 109.1 m depth (PNNL-11957). The interval tested at well 299-E24-21 was entirely in the Hanford formation gravel sequence between 95.2 and 101.3 m depth. The best-fit value to the data from 299-E17-21 indicated a hydraulic conductivity of about 68.6 meters per day (PNNL-11957) and from 299-E24-21 suggested a hydraulic conductivity of 75 meters per day (PNNL-13652).

5.4 CONTAMINANT PLUME DESCRIPTION [D-10d]

Although no groundwater monitoring has been done for the IDF, groundwater monitoring has been done in support of RCRA permitting activities and in support of other activities in the area. The results of that monitoring show that a regional nitrate plume exists beneath the IDF site (PNNL-14187). In the south-central 200 East Area, the plume extends in a northwest - southeast direction along the axis of the Columbia River/Missoula flood channel eroded into the Ringold Formation sediments. The channel is filled with more transmissive Hanford formation sediments.

5.4.1 Groundwater Contamination

Nitrate, associated with past-practice activities in 200 East Area, is a general groundwater chemistry parameter and is not a contaminant of concern for the IDF. However, the distribution of existing nitrate in the groundwater gives an indication of the general groundwater flow direction and the influence that adjacent sites might have on the IDF.

High nitrate concentrations found near liquid waste disposal facilities located outside the IDF site that received effluent from the PUREX Plant are decreasing steadily with time. The highest nitrate concentration found in 2002 was 170,000 μg/L in well 299-E17-9 at the 216-A-36B crib and the crib is thought to be the source of the nitrate. The drinking water standard for nitrate is 45,000 μg/L (nitrate ion).

Nitrate in well 299-E24-18, just inside the east boundary of the IDF site, decreased from a high of 86,300 μg/L in 1990 to a low of 17,000 μg/L in 1993, reflecting the cessation of PUREX Plant operations in 1988. Since 1993, nitrate has increased to 48,300 μg/L in 2003 (Figure 5-7). The reason for the increase is not understood. One possibility is related to changing groundwater flow direction. During PUREX Plant operations, flow direction was probably to the northwest because of effluent discharges to the B Pond System and PUREX Plant cribs, and nitrate contamination might have spread to the northwest during that period. Subsequently, liquid discharges to the B Pond System and PUREX Plant cribs have ceased and the flow direction in the area of the IDF site apparently has returned to the southeast direction. With that change, higher levels of nitrate-contaminated groundwater might be returning to the area from the northwest.

Except for an anomalous value of 82,600 µg/L in 1988, nitrate concentration in well 299-E24-7 was fairly steady and ranged between 12,800 and 35,400 µg/L between 1985 and 1996 when the well was last sampled (Figure 5-7). The last two measured values from 1995 and 1996 were 26,000 µg/L. Farther southwest, nitrate detected in 1998 in well 299-E17-21 in Ringold unit E was 23,600 µg/L.

5.4.2 Vadose Zone Contamination

Very little characterization and monitoring of the soil have been done at the IDF site because no major construction or waste disposal activities have occurred in this part of the Hanford Site. A pre-operational environmental monitoring plan (RPP-6877) for the disposal facility was issued in 2000. Implementation of that plan has begun and characterization activities will occur during the next few years. The pre-operational environmental monitoring plan has a strong emphasis on vadose zone characterization and deferred groundwater monitoring to this groundwater monitoring plan. Vadose zone information resulting from pre-operational monitoring will be included, if applicable, in updates to this groundwater monitoring plan.

The pre-operational monitoring plan identified three areas near the IDF site that might have had an influence on the vadose zone beneath the site. These are the 218-E-1 Burial Ground and an unplanned release associated with the burial ground; the coal ash pile in the northwest part of the site; and a transfer line along the northern part of the west boundary of the IDF site (RPP-6877). Work was outlined in the pre-operational monitoring plan to determine whether these three areas had introduced contamination to the site. Appropriate results from pre-operational monitoring will be incorporated into this groundwater monitoring plan as results become available and as revisions are needed.

In addition to these facilities, the 216-A-38-1, 216-A-45, and 216-A-10 cribs and the 299-E24-111 injection well are located east of the IDF site. The 216-A-38-1 crib never was used (DOE/RL-92-04). The 299-E24-111 injection well never received any waste (DOE/RL-92-04). The 216-A-45 and the 216-A 10 cribs both received large quantities of liquid waste (DOE/RL-92-04). Because these latter two facilities are more than 200 meters from the IDF site, it is unlikely these facilities have affected the soil beneath the IDF site. Data from the vadose zone in IDF wells drilled along the east side of the site support this.

5.5 DETECTION MONITORING PROGRAM [D-10e]

Because the IDF has not been constructed, no contaminants have been released to the ground or to the groundwater.

5.5.1 Indicator Parameters, Waste Constituents, Reaction Products to be Monitored [D-10e(1)]

Regulated Constituents

The regulated constituents for this groundwater monitoring plan are the constituents identified on the Part A Permit application included in Chapter 1 of this document.

Monitoring Parameters

The parameters to be routinely monitored are listed in Table 5.2. These parameters include the indicator parameters and supplemental parameters.

The indicator parameters will be used to monitor for hazardous constituents reaching the groundwater as a result of IDF operations. Only the indicator parameters are subject to the statistical methods described in Section 5.5.4.7. Total organic carbon and total organic halides are indicator parameters selected to monitor impacts of RCRA regulated organic constituents on the groundwater quality. Specific conductance is selected as an indicator parameter to monitor impacts of metals and anions on groundwater quality. pH is a general indicator of groundwater quality. Specific conductance and pH are measured in the field at the time of sampling. Chromium is included as an indicator parameter because hexavalent chromium is one of the more mobile of the regulated metals to be disposed of at the IDF and should be one of the first constituents to enter groundwater if the regulated facility impacts groundwater.

Analyses of alkalinity, anions, and metals are to provide supplemental data on general groundwater chemistry beneath the IDF. This information aids data interpretation and quality control. Supplemental parameters will not be used in statistical evaluations. Turbidity is analyzed at the well just before sampling and provides an indication of the groundwater condition at the time of sampling.

For the first year of monitoring, all parameters listed in Table 5-2 will be monitored twice each quarter to determine background concentrations. After the first year, indicator and supplemental parameters will be monitored semi-annually. In addition, field measurements of temperature and turbidity will be made at each sampling event.

During the first sampling event at each well for the first year of monitoring, samples will be collected for analysis of the indicator parameters, the supplemental parameters, and the Appendix IX constituents (40 CFR 264) included in Chapter 1 of this permit application. After the first sampling event, samples will be collected for analysis of indicator parameters and supplemental parameters only.

After the first year of sampling, if an indicator parameter suggests there is an impact to groundwater, additional samples will be collected to verify the initial results. If a statistically significant increase in any indicator parameter is confirmed, analyses will be made for the regulated parameters in Chapter 1.

5.5.1.1 Dangerous Waste Characterization [D-10e(1)(a)]

This section describes the waste to be disposed in the IDF and gives background information on how the constituents of concern (regulated constituents) and indicator parameters were selected.

Volume of the Waste Package

The IDF will be a single, expandable disposal facility constructed to RCRA Subtitle C standards, half of which is for disposal of mixed waste the other half will be for disposal of low-level waste. Initial capacity for mixed waste disposal is 82,000 cubic meters of waste with an ultimate capacity of up to 450,000 cubic meters of waste. Disposal capacity beyond the initial 82,000 cubic meters will require a modification to the Part B Permit. The mixed waste types to be disposed in the IDF include vitrified LAW from the RPP-WTP and DBVS. Additionally, mixed waste generated by IDF operations will be disposed of in IDF.

The vitrified LAW will be mostly silicate glass monoliths. The RPP-WTP packages nominally measure approximately 1.22 m diameter by 2.3 m high and the DBVS package nominally measure approximately 2.4 m wide by 3.1 m high by 7.3 m long. Vitrified LAW will be remote handled.

If other forms of immobilized LAW are considered in the future, this monitoring plan will be amended.

Mixed waste generated through waste operations at IDF will be packaged based on the size of the waste, with the most common container being galvanized or aluminized 208 liter containers.

Composition of the Waste Packages

HNF-4921 provides detailed estimates for the inventory of hazardous chemicals in the vitrified LAW feed and in the vitrified LAW package. The composition of the vitrified LAW package was estimated in HNF-4921 based on

(1) the Tank Waste Retrieval System Characterization Program tank-by-tank Best Basis Inventories,

(2) the latest U.S. Department of Energy, Office of River Protection (DOE/ORP) guidance,

(3) the requirements for waste retrieval and vitrification,

(4) available information from waste treatment plant contractors, and (5) proposed operating scenarios for retrieval of waste from DSTs and SSTs.

5.5.1.2 Behavior of Constituents [D-10e(1)(b)]

Almost all of the regulated constituents for the IDF show some degree of retardation in the vadose zone and in the saturated zone. Table 5.3 indicates the range of expected behaviors in the subsurface at the IDF for selected regulated constituents. The constituents in Table 5.3 were selected by comparing the expected constituents in the vitrified LAW package (from HNF-4921) and the historical inventories of the Hanford Site low-level burial grounds (from WHC-MR-0008 and WHC-SD-EN-AP-015) to 40 CFR 264, Appendix IX (see Chapter 1). The mobilities and solubilities in Table 5.3 give an estimated range for the properties of the constituents of concern.

5.5.1.3 Detectability [D-10e(1)(c)]

The detection limits in groundwater for each RCRA regulated constituent and the indicator parameters are given in Table 5-4.

5.5.2 Groundwater Monitoring Program [D-10e(2)]

The following sections provide a description of wells, equipment decontamination, representative samples, and monitoring wells that are not upgradient.

5.5.2.1 Description of Wells [D-10e(2)(a)]

The groundwater monitoring well network for the IDF ultimately will have eight wells: three hydraulically upgradient of the facility and five hydraulically downgradient. The downgradient wells will be placed to sample groundwater passing the point of compliance. The point of compliance at the IDF site is a plane connecting the groundwater monitoring wells along the southern and eastern sides of the site in accordance with WAC 173-303-645 (6), which states "The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated unit". The monitoring network will consist of existing and new, downgradient wells to complete the monitoring network. All wells will be WAC 173-160 compliant.

Three upgradient wells will be used for the IDF monitoring network. Two of these wells (299-E18-1 and 299-E24-21) are existing wells. Upgradient well 299-E24-21 was installed in March 2001 for characterization of the IDF site. The well, located at the northeast corner of the site (Figure 5-8), was constructed to RCRA standards as per WAC 173-160. Well 299-E18-1 was installed in 1988 as part of the 2101-M RCRA monitoring network. The well currently has 2 to 3 meters of water above the bottom of the screened interval.

The third upgradient well will be a new well located at the northwest corner of the IDF (Figure 5-8). The well will be constructed to RCRA standard as per WAC 173-160 and screened at the water table.

Three of the downgradient wells are existing wells (299-E17-22, 299-E17-23, and 299-E17-25) that were installed as WAC 173-160 compliant wells in 2002. Their location is shown in Figure 5-8. The remaining two downgradient wells will be installed in a sequence coordinated with the IDF operations.

Three phases of trench construction are assumed for the purposes of this monitoring plan. Excavation for the first phase is scheduled for September 2004 and a new phase is planned for every ten subsequent years. Changes in the planned operations of the IDF will be reflected in changes to this groundwater monitoring plan as needed.

The first new downgradient well will be installed along the eastern side of the facility (Figure 5-8) at least one year before the IDF receives waste. The second new downgradient well will be installed along the southern boundary of the Site at least one year before the third phase of waste disposal becomes operational. Both wells will be installed such that at least one year of background data can be obtained prior to the associated operational phase becoming active. Figure 5-8 shows the sequence for both groundwater well construction and waste disposal. The locations of all existing and new wells in the IDF monitoring network are noted on the figure.

The placement of the wells for the IDF monitoring network was based on professional judgment. The efficiency of the resulting groundwater monitoring network was evaluated using a simple two dimensional, horizontal transport model called the monitoring efficiency model (MEMO) (Wilson et al. 1992). The model estimates the efficiency of a monitoring network at the point of compliance. The model simulates a contaminant plume originating from a series of grid points within the disposal facility using the Domenico-Robbins method (Domenico and Robbins 1985). The model calculates both advective flow and dispersive flow in two dimensions and determines whether the resulting plume will be detected by a monitoring well before the plume travels some selected distance beyond the disposal facility boundary. The selected distance is termed the buffer zone. (A longitudinal dispersivity of 95 meters and horizontal dispersivity of 9.5 meters were used to evaluate the monitoring network in Figure 5-8.) Outputs from the model are the monitoring efficiency and a map of the disposal facility showing areas where leaks would not be detected under the given site-specific parameters provided as input to the model. Monitoring efficiency is defined as the ratio of the area within a disposal facility from which a release likely would be detected to the total area of the disposal facility, expressed as a percentage.

The monitoring efficiency calculated by the MEMO model for the proposed monitoring network is 100% for phase I, 98% for phase II, and 99% for phase III (Figure 5-8).

All wells for the IDF site will be constructed to meet WAC 173-160 requirements. The wells will be protected at the surface with a concrete pad, protective posts, a protective outer casing, and locking cap. The casing and screen will be stainless steel, an appropriate filter pack for the screen slot size will be used, and an annular seal of bentonite and cement will be emplaced. All wells will be screened at the water table with 10.6 meter long screens, which will accommodate the greatest possible future decrease in water level. The wells will be developed and dedicated sampling pumps will be installed.

New wells will be surveyed with a down hole gyroscope at the time of construction to determine any deviation from vertical so that corrections can be made to subsequent water level measurements. Gyroscope surveys will also be conducted on existing wells in the network prior to IDF operations.

5.5.2.2 Equipment Decontamination [D-10e(2)(b)]

Drilling equipment will be decontaminated using high temperature and pressure [82°C (180°F) and greater than 70.3 kg/cm^2 (1,000 psi)] washing with an approved cleaning solution. The equipment will be rinsed with clean water. The procedure is specified in controlled manuals.

Equipment for collecting soil samples during drilling for later chemical analysis and for measuring the water table will be decontaminated according to established methods. The methods call for washing equipment with phosphate-free detergent, rinsing three times with reverse osmosis/de-ionized water, rinsing once with 1M or 10% nitric acid (glass or stainless steel equipment only), rinsing three more times with reverse osmosis/de-ionized water, and a final rinse with chromatograph grade hexane. Equipment will be dried for 50 minutes at 100°C (212°F). After drying, equipment will be wrapped in unused aluminum foil and sealed with tape.

No decontamination of groundwater sampling equipment will be necessary because each well will have a dedicated pump.

5.5.2.3 Representative Samples [D-10e(2)(c)]

No groundwater chemistry data specific to the IDF site are available. Sample representativeness will be addressed after collection of the first year of background data.

5.5.2.4 Locations of Background Groundwater Monitoring Wells that are not Upgradient [D-10e(2)(d)]

All background groundwater monitoring wells at the IDF are located upgradient.

5.5.3 Background Values

Groundwater background (baseline) has not been established for the IDF site. Background data will be determined before construction of the site using the wells described previously (Section 5.5.2.1) for the use of upgradient vs. downgradient comparisons (Section 5.5.4.7).

5.5.3.1 Plan for Establishing Groundwater Quality Data [D-10e(3)(b)]

Well location, sampling frequency, sampling quantity, and background values are discussed in the following sections.

5.5.3.1.1 Well Locations [D-10e(3)(b)(i)]

Groundwater monitoring wells in the IDF monitoring network were described in Section 5.5.2.1 and their locations are shown on Figure 5-8.

5.5.3.1.2 Sampling Frequency [D-10e(3)(B)(ii)]

Eight background samples will be collected during the first year of monitoring from phase I wells. Two samples will be collected quarterly for one year. For the new well needed for phase III operations, two samples will be collected quarterly for one year before phase III is operational. For all wells, two independent samples will be collected each quarter, one per month for 2 consecutive months followed by a month of non-sampling. This sequence will be repeated each quarter during the first year of monitoring. Section 5.5.3.1.3 provides frequency logic.

5.5.3.1.3 Sampling Quantity [D-10-e(3)(b)(iii)]

The performance of the statistical method proposed for the IDF is evaluated by the following two goals:

- To have adequate statistical power to detect real contamination when contamination occurs
- To keep the network-wide Type I error (across all constituents and wells being tested) at an acceptably low level (approximately 5%). [Note that the Type I error in the detection monitoring stage equates to the false positive rate, that is, the probability that the test will indicate contamination has occurred although no contamination has truly occurred.]

The statistical power and the network-side false-positive rate of a test depend on several factors, including the background sample size, the type of proposed test, and the number of comparisons. All other factors being equal, the larger the sample size is (i.e., the number of background samples), the greater the statistical power is. Therefore, as recommended in EPA/530-R-93-003, at least eight independent samples will be collected from each well for background purposes. This is a sufficient number of samples to establish a reliable background (EPA/530-R-93-003) and meets the regulations in WAC-173-303-645(9)(d).

5.5.3.1.4 Background Values

The default method of analysis of variance (ANOVA) will be used to detect any impact on groundwater quality at the IDF where the mean of the measurements from compliance (downgradient) wells is compared to the mean of the distribution of background data from the upgradient wells. The details of the method are described in Section 5.5.4.7.1.

5.5.4 Sampling, Analysis and Statistical Procedures [D-10e(4)]

Sample collection, sample preservation and transfer/shipment, analytical procedures, chain of custody and additional requirements for compliance point monitoring are discussed in the following sections.

5.5.4.1 Sample Collection [D-10e4(a)]

Groundwater sampling procedures, sample collection documentation, sample preservation and transfer/shipment, and chain-of-custody requirements are described in subcontractor operating procedures/manuals and in a quality assurance project plan for the Hanford Groundwater Performance Assessment Project. Quality requirements for sampling activities, including requirements for procedures, containers, transport, storage, chain of custody, and records requirements, are specified in a statement of work (SOW) to subcontractors. To ensure that samples of known quality are obtained, the subcontractor will be required to use contractor-controlled procedures based on standard methods for groundwater sampling whenever possible. The procedures will be reviewed for technical quality and consistency. In addition, periodic assessments of sample collection activities will be performed to further ensure that procedures are followed to maintain sample quality and integrity. The following is a brief description of the sampling requirements.

Samples generally will be collected after three casing volumes of groundwater are withdrawn or after the field parameters pH, temperature, and specific conductance have stabilized. Field parameters are measured in a flow-through chamber. Turbidity should be equal to or below 5 NTU (nephelometric turbidity units) before sample collection if possible. Sample preservatives will be added to the collection bottles in the laboratory before their use in the field. Samples to be analyzed for metals will be filtered in the field to ensure results represent dissolved metals and do not include particulates (40 CFR 136.3). Duplicates, trip blanks, and field equipment blanks will be collected as part of the general quality control program.

Water level measurements will be made each time a well is sampled. Procedures developed in accordance with the techniques described in American Society for Testing and Materials (1988), Garber and Koopman (1968), OSWER 9950.1, and U. S. Geological Survey (1977) will be followed to measure water levels. Water levels will be measured primarily with laminated steel electrical sounding tapes, although graduated steel tapes are used occasionally.

5.5.4.2 Sample Preservation and Shipment [D-10e(4)(b)]

Sample preservation will be done in accordance with existing procedures. A chemical preservative label will be affixed to the sample container listing the specific preservative. The brand name, lot number, concentration, and date opened of the preservatives will be recorded. A calibrated dispenser or pipette will be used to dispense preservatives. Appropriate measures will be taken to eliminate any potential for cross contamination.

Sample packaging and transfer/shipping will be done in accordance with subcontract procedures. Samples will be labeled and sealed with evidence tape, wrapped with bubble wrap, and placed in a

Department of Transportation approved container with coolant (if required). Hazardous samples will have packaging parameters determined by associated hazards. A chain of custody will accompany all samples.

5.5.4.3 Analytical Procedures [D-10e(4)(c)]

The methods for analysis of chemical constituents in groundwater will conform to *Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods, 3rd Ed.* (SW-846); *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020) or other EPA methods; and the *Annual Book of ASTM Standards* (American Society for Testing and Materials, 1986). The methods used to obtain routine data results are presented in Table 5-4.

5.5.4.3.1 Data Storage and Retrieval

All contract analytical laboratory results will be submitted by the laboratory to be loaded into the Hanford Environmental Information System (HEIS) database. Most data are received from the laboratory in electronic form, and will be loaded electronically. Parameters measured in the field will be entered into HEIS either manually or through electronic transfer. Hard copy data reports are received for records storage. Data from the HEIS database will be retrieved for data validation, data reduction, and trend analysis. Copies of supporting analytical data will be sent yearly to Pacific Northwest National Laboratory (PNNL) for storage.

5.5.4.3.2 Data Verification and Validation

Verification of analytical data provided by the subcontracted laboratory will be performed in accordance with established procedure. This procedure includes checks for: (1) completeness of hardcopy deliverable, (2) condition of samples on receipt by the laboratory, (3) problems that arose during the analysis of the samples, and (4) correct reporting of results. The procedure also describes the actions to be taken if data are incomplete or deficient.

Verification and validation of groundwater chemistry data will be performed according to established procedures. Data will be reviewed quarterly to assure the data are complete and representative. The review will include evaluation of quality control data (e.g., field blanks, duplicates, and laboratory blanks) and a technical review by a project scientist familiar with the hydrogeology of the site. The technical review might include comparison of recent data to historical trends and comparison of related constituents. Suspect data will be investigated through the data review process in accordance with established procedures and will be flagged in the database.

5.5.4.3.3 Reporting

Groundwater chemistry and water level data will be reviewed after each sampling event and will be available in the HEIS database. The results of the statistical evaluation and associated information will be submitted to Ecology quarterly in Hanford Site groundwater monitoring reports.

If statistically significant evidence of contamination is determined (after waste has been introduced to the facility and after the confirmation re-sampling evaluation process) for one or more of the indicator parameters at any monitoring well at the compliance point, and if the owner or operator decides not to make a false-positive claim, the following will be performed.

- Notify Ecology in writing within 7 days of the finding indicating which chemical parameters or dangerous waste constituents have shown statistically significant evidence of contamination.

- Determine whether dangerous constituents are present and, if so, in what concentration.

- The owner or operator might re-sample within 1 month and repeat the analysis for those compounds detected in the above (i.e., second bullet). The resample data will be compared with the trigger value.
- Submit an application for a permit modification, if necessary, to establish a compliance-monitoring program to Ecology in 90 days or within the time agreed to in writing by Ecology.

The dangerous constituents detected, either in the initial analysis or in the second confirmation analysis, will form the basis for compliance monitoring.

In case of a false-positive claim [as allowed by WAC 173-303-645 (9)(g)(vi)], the following will apply.

- Notify Ecology in writing within 7 days of the finding (i.e., exceedance) and indicate that a false-positive claim will be made.
- Submit a report to Ecology within 90 days or within the time agreed to in writing by Ecology. This report should demonstrate that a source other than the regulated unit caused the contamination or that the contamination resulted from an error in sampling, analysis, evaluation, or natural variation in groundwater chemistry.
- Submit an application for a permit modification, if necessary, to make any appropriate changes to the detection-monitoring program within 90 days or within the time agreed to in writing by Ecology.
- Continue to monitor in accordance with the detection-monitoring program.
- Submit an application for a permit modification, if the detection monitoring program is determined to no longer satisfy the requirements [of WAC 173-303-645(9)], to make any appropriate changes to the program within 90 days or within the time agreed to in writing by Ecology.

5.5.4.4 Chain of Custody [D-10e(4)(d)]

The procedures used for chain-of-custody control of samples are documented in existing manuals. The procedure requires that each transfer of custody shall be documented by the signatures of the custodian relinquishing the samples and the custodian receiving the samples, as well as the time and date of transfer. The laboratory custodian will sign and date the chain-of-custody form upon receipt of the samples at the laboratory.

5.5.4.5 Additional Requirements for Compliance Point Monitoring [D-10e(4)(e)]

This section describes sampling frequency and determination of groundwater quality for the samples from the groundwater monitoring network. Compliance data will be compared to baseline data collected from the upgradient wells and a determination of impacts to groundwater will be made using the proposed ANOVA method (explained in Section 5.5.4.7.1).

5.5.4.5.1 Sampling Frequency [D-10e(4)(e) (i)]

Under final status regulations, the default sampling procedure states that a sequence of at least four samples from each well (background and compliance wells) must be collected at least semiannually during detection monitoring at an interval that ensures, to the greatest extent technically feasible, that an independent sample is obtained [40 CFR 264.97(g)(1) and (2), WAC 173-303-645 (8)(g)(i) and (ii), and (9)(d)].

The default sampling procedures are adopted for the IDF as follows: four independent samples from each groundwater monitoring well will be sampled for the indicator parameters (Table 5-2) semiannually during the active life of the regulated unit (including the closure period), one per month for 4 consecutive months followed by two months of non-sampling. The mean of the measurements from the downgradient wells will be compared semiannually to the mean of the distribution of the background data using ANOVA.

5.5.4.5.2 Compliance Point Groundwater Quality Values [D-10e(4)(e)(ii)]

The groundwater quality data collected from the groundwater monitoring wells will be compared to the mean of the background data from upgradient wells for each constituent by ANOVA. If the mean is calculated from transformed baseline data (logarithmic transformation or nonparametric approach), then the monitoring data will be transformed accordingly; otherwise, the original monitoring data will be used in the comparisons.

During detection monitoring, data verification will be applied in case of an initial exceedance. For ANOVA test, if the test of hypothesis of equal means for all wells fails, *post hoc* comparisons are needed to determine which compliance well(s) is (are) contaminated. This will be done by comparing concentration differences (called contrasts in the ANOVA and multiple comparison framework) between each compliance well with the background wells (EPA/530-SW-89-026). If the contaminated compliance well(s) is (are) determined by *post hoc* comparisons, verification sampling will be implemented for the constituent(s) in question. Verification sampling is needed to determine if the exceedance is an artifact caused by an error in sampling, analysis, or statistical evaluation or an actual variation in groundwater chemistry. A collection of at least four measurements from the re-sampled compliance well(s) is required to perform ANOVA test on comparison with the mean of the background data (EPA/530-R-93-003). Adequate time should elapse to ensure statistical independence between the original measurements and the re-sample measurements, which is assured by the sampling frequency proposed in Section 5.5.4.5.1.

The existing nitrate plume beneath the IDF site is described in Section 5.4.1. Nitrate is not included in Chapter 1 and, therefore, is not a constituent of concern for the IDF. Existing groundwater conditions will be monitored by the indicator parameters and supplemental constituents as described in Section 5.5.1. Specific conductance will respond to nitrate so that any changes in the nitrate concentration will be reflected by changes in the indicator parameter specific conductance.

Anion analysis is one of the supplemental constituents to be monitored at the IDF site. Anion analysis will determine the nitrate concentration. Therefore, through comparison of regression lines of specific conductance and nitrate (Zar, 1999) and/or contaminant source analysis (Gibbons, 1994), it can be determined whether any change in specific conductance is due to a change in nitrate. If a change in specific conductance is due to a change in nitrate, then that specific conductance change is not attributed to the IDF. If, however, a statistically significant change in specific conductance is not attributable to nitrate, verification sampling will occur as described above.

5.5.4.6 Annual Determination [D-10e(4)(f)]

Groundwater flow rate and flow direction at the IDF site will be determined annually for the uppermost aquifer. Flow rate will be determined by calculation using the groundwater gradient, and the Darcy flow equation, $v_h = K_h i_h / n_e$, where v_h is the horizontal groundwater velocity, K_h is the horizontal hydraulic conductivity, i_h is the horizontal hydraulic gradient, and n_e is the effective porosity. Effective porosities used at Hanford Site RCRA regulated units are on the order of 0.1 to 0.3 (PNNL-14187); effective porosity might be determined specifically for the IDF from hydrologic tests.

Hydraulic gradients will be determined from measurements of water levels.

5.5.4.7 Statistical Determination [D-10e(4)(g)]

This section describes the method of statistical evaluation and the statistical procedures to indicate whether dangerous waste or dangerous waste constituents from the IDF might have entered the groundwater in the uppermost aquifer. These evaluations will be made as soon as practicable after validation of the full data set from each sampling event.

The monitoring program periodically will re-evaluate the statistical tests being used. The methods described will be reviewed during and after background data are collected to ensure the methods are the most appropriate, considering site conditions.

The goal of a RCRA final status detection-monitoring program [WAC 173-303-645(9)] is to monitor for indicator parameters that provide a reliable indication of the presence of dangerous constituents in groundwater in the uppermost aquifer beneath the site. This is accomplished by testing for statistically significant changes in concentrations of indicators in downgradient wells relative to baseline values. The default statistical method ANOVA is proposed for the detection monitoring program of the IDF. The proposed statistical method is consistent with EPA/530-SW-89-026, EPA/530-R-93-003, and WAC-173-303-645.

The number of tested constituents will be limited to the indicators to maintain a sufficiently low false-positive rate (EPA/530-R-93-003, page 62; Gibbons 1994, page 16). Verification sampling is an integral part of the statistical design to lower the overall false-positive rate and determine whether the difference between background and compliance-point data is an artifact caused by an error in sampling, analysis, or statistical evaluation (Section 5.5.4.5.2).

5.5.4.7.1 Statistical Procedure [D-10e(4)(g)(i)]

In accordance with WAC 173-303-645(8)(h), acceptable statistical methodology includes analysis of variance (ANOVA), tolerance intervals, prediction intervals, control charts, test of proportions, or other statistical methods approved by Ecology. The type of monitoring, the nature of the data, the proportions of non-detects, and spatial and temporal variations are some of the important factors to be considered in the selection of appropriate statistical methods. The EPA default method ANOVA will be implemented for the IDF site to compare the differences of means of the measurements from upgradient and downgradient wells. The detailed discussions of the ANOVA test can be found in EPA/530-SW-89-026 and statistical textbooks (Gilbert, 1987; Casella and Berger, 1990; Davis, 2002), and can be executed using commercial statistical software such as SAS or SYSTAT. Under WAC 173-303-645(8)(i)(ii), the proposed statistical method must comply with the performance standard, that is, for a multiple comparisons procedure the Type I error level must be no less than 0.05, and maintained at the level of no less than 0.01 for individual well comparisons. By definition, Type I error is the false rejection rate of the null hypothesis (H_0) of the statistical test. In detection or compliance monitoring, the statistical test is defined as H_0: no release, i.e., the means of the distributions from upgradient and downgradient wells are the same, and the alternative (H_a) evidence of release, e.g., "clean until proven contaminated"(EPA/530-R-93-003). Therefore, the proposed statistical method must comply with the requirement of maintaining Type I error which equates false positive rate in the stage of detection monitoring at approximate 5% level. As described in EPA/530-SW-89-026, ANOVA procedures have the advantages of combining multiple downgradient into a single statistical test, thus enabling the network-wide false positive rate for any single constituent (not multiple constituents) to be kept at 5%, and also maintain reasonable power for detecting contamination.

The details of the ANOVA procedures are described as follows (EPA/530-SW-89-026):

- First, check the proportion of non-detects of the measurements from the upgradient and downgradient wells. When the proportion of non-detects is less than 15%, the non-detects will be reported as one-half the minimum detection limit or practical quantitation limit, and proceed with parametric ANOVA analysis. When the proportion of non-detects is greater than 15%, non-parametric ANOVA analysis will be used for comparing the means of downgradient and upgradient wells.

- Evaluate the distributions of the measurements from the upgradient and downgradient wells. The assumptions with parametric ANOVA test are the residuals are normally distributed with equal variance. The normality of the distribution the residuals can be checked using coefficient of variation, plotting the data on probability plot, and/or Shapiro-Wilk's test (EPA/530-SW-89-026; Gibbons, 1994). The assumption of normality usually can be met by log-transforming the data or by other Box-Cox transformations. When the assumptions of normality and lognormality cannot be justified, the non-parametric ANOVA method will be used for the IDF. Bartlett's test can be used in checking equality, or homogeneity, of variances.

- The parametric ANOVA procedures include:

  - Assume a monitoring network with k wells, and total number of observations N. First, compute well total, well mean, and well residuals (observations subtracted by well mean) for each well, and grand total and mean of all observations (all wells). The well residuals are used to check the assumption of normality.

  - Compute the sum of squares of difference between well means and the grand mean, SS_{wells} which is a measure of the variability between wells with (k-1) degrees of freedom.

  - Compute the total sum of squares of differences between all observations and the grand mean, SS_{total}, which is a measure of the variability in all observations with (N-1) degrees of freedom.

  - Compute the sum of squares of differences of observations within wells from the well means, SS_{error}, which is a measure of the variability within wells with (N-k) degrees of freedom calculated by the following subtraction:

    $$SS_{error} = SS_{total} - SS_{wells}$$

  - Test the hypothesis of equal means for all k wells by computing F value with the means squares of differences:

    $$F = MS_{wells} / MS_{error}$$

    where the means of squares are the sums of squares divided by the associated degrees of freedom, that is, $MS_{wells} = SS_{wells} / (k-1)$, and $MS_{error} = SS_{error} / (N-k)$. Compare the F value to the tabulated F statistics with (k-1) and (N-k) degress of freedom at the 5% significance level (EPA/530-SW-89-026, Appendix B, Table 2). If the calculated F value exceeds the tabulated F statistics, the null hypothesis of equal well means is rejected. Proceed with test of contrasts in the next step. Otherwise, the hypothesis of equal means is accepted that there is no significant difference between the concentrations at k wells (upgradient and downgradient wells), that is, no evidence of contamination.

  - If the hypothesis of equal well means is rejected, contrasts (concentration differences between a compliance well and background wells) will be tested for each compliance well to determine which compliance well(s) is (are) contaminated. Bonferroni t-statistics will be computed to determine if the significant F value is due to difference between background and compliance wells. Assume that of the k wells, k_b are background (upgradient) wells, and k_c are compliance (downgradient) wells (i.e., $k_b + k_c = k$). Each of the k_c compliance wells is compared to the mean of the background wells as the following steps:

    - Compute the mean m_b from the k_b background wells with a total of n_b samples.

    - Compute the difference D_i between the mean from the i^{th} compliance well and the mean from the background wells.

- Compute the standard error of the difference from the i^{th} compliance well with n_i observations as:

  $SE_i = [MS_{error} (1/n_b + 1/n_i)]^{1/2}$

  where MS_{error} is computed previously as the measure of variability within wells.

- Obtain the t-statistics from Bonferroni's t-table (EPA/530-SW-89-026, Appendix B, Table 3) with a significance level of (α=0.05/k_c) but no less than 0.01 (for individual comparison) and (N-k) degrees of freedom. The critical value for the i^{th} compliance well is defined as: $C_i = SE_i \times t$.

- If the difference D_i exceeds the critical value C_i, conclude that the mean of the i^{th} compliance well is significantly higher than the mean of the background wells. Otherwise conclude that the well is not contaminated.

- The one-way non-parametric ANOVA tests the null hypothesis that the data from each well come from the same continuous distribution and hence have the same median. The procedures, called the Kruskal-Wallis test, include the following steps:

  - Assume the monitoring network as defined previously with a total of N observations from k wells (k_b background wells and k_c compliance wells). Rank all N observations from least (1) to greatest (N). Let the background wells be group 1, and denote the compliance wells as group 2 to (k_c+1). (one group per compliance well).

  - Compute the sum (R_i) and the average (m_i) of the ranks of the n_i observations in the i^{th} group.

  - Compute the Kruskal-Wallis statistics (H) as

$$H = \left[\frac{12}{N(N+1)} \sum_{i=1}^{kc+1} \frac{R_i^2}{n_i} \right] - 3(N+1)$$

  - Compare the calculated H value to the tabulated chi-squared value with k_c degrees of freedom (EPA/530-SW-89-026, Appendix B, Table 1). The null hypothesis of equal medians is rejected when the calculated H value exceeds the tabulated critical value.

  - When the null hypothesis of equal medians is rejected, compute the critical difference C_i for each compliance well to the background data (group 1 with n_b observations):

$$C_i = Z_{(0.05/kc)} \left[\frac{N(N+1)}{12} \times \left(\frac{1}{n_b} + \frac{1}{n_i} \right) \right]^{1/2}$$

    where $Z_{(0.05/kc)}$ is the upper (0.05/k_c) percentile from the standard normal distribution (EPA/530-SW-89-026, Appendix B, Table 4). If there are more than five compliance wells ($k_c > 5$), use $Z_{0.01}$, the upper one-percentile from the standard normal distribution ($Z_{0.01}$=2.32) for individual comparison (WAC-173-303-645(8)(i)(ii)).

  - Compute the difference ($D_i = m_i - m_1$) of average rank m_i (i=2 to k_c+1) for each compliance well to the background (m_1). Compare the difference D_i to the critical value C_i for each compliance well. If D_i exceeds C_i, conclude that the median of the i^{th} compliance well is significantly higher than the background median.

- As monitoring continues, the background data will be updated periodically (e.g., every year or two) to incorporate the new data from upgradient wells. This updating process will continue for the life of the monitoring program. Prior to updating older background data with more recent results, a two-sample t-test will be run to compare the older concentration levels with the concentrations of the proposed update samples. If the t-test does not show a significant difference at the 5 percent significant level, proceed to re-estimate the baseline parameters by including the more recent data. If the t-test does show a significant difference, the newer data will not be included as background unless some specific factors can be identified explaining why background levels at the IDF site have naturally changed (EPA/530-R93-003).

Formal testing for outliers will be done when an observation of the background data seems inconsistently high (by orders of magnitude) compared to the rest of the data set in order to avoid the artificial increase of the mean of the background data and a corresponding increase of the false negative rate. Statistical methods such as the Grubbs' method (Grubbs, 1969), the box-and-whisker plot (Ostle and Malone, 1988), EPA guidance (EPA/530-SW-89-026, page 11-14) and/or American Society for Testing and Materials guidance (ASTM, 1996) will be used for testing outliers. The outliers must be checked to determine if the measurements are in error and need to be corrected or excluded from calculating the background mean. If no specific error is found, the measurements must be retained in the data.

A statistically significant exceedance over background (baseline) levels only indicates that the new measurement in a particular monitoring well for a particular constituent is inconsistent with chance expectations based on the available sample of background (baseline) measurements. Any statistical result must be supported by other information to determine if a waste disposal facility has impacted groundwater (ASTM 1996).

5.5.4.7.2 Results [D-10e(4)(g)(ii)]

Sampling and analysis results are reviewed at least semiannually (i.e., after each sampling event) and are available in HEIS. The DOE will submit results of statistical evaluations to Ecology.

5.5.5 Compliance Monitoring Program [D-10f]

A compliance monitoring program that satisfies requirements set forth in WAC 173-303-645(10) will be established for the IDF if detection-level monitoring reveals statistically significant evidence of dangerous waste contamination from sources within the regulated unit. If compliance monitoring is required, DOE will submit a revised monitoring plan to Ecology specifying dangerous constituents to be monitored, sampling and analysis protocols, statistical evaluation methods, etc. In the compliance monitoring program, the dangerous constituents or parameters will be compared to concentration limits specified in the facility permit as discussed in WAC 173-303-645(5) during the compliance period.

The RCRA regulations [WAC 173-303-645(9)(g)] state that if a statistical exceedance occurs in a downgradient well, the entire network immediately must be resampled and analyzed for the constituents in Appendix IX of 40 CFR 264. This sampling would be conducted in parallel with a required permit modification. Appendix IX is an extensive list including a wide variety of volatile and semivolatile organic compounds and trace metals. It is prudent to narrow the analyte list to the specific exceedance event; e.g., if the exceeding contaminant is total organic halides, the project would analyze for the halogenated hydrocarbons most likely to be present in the area. Results of the resampling will form the basis for returning to detection monitoring or designing a compliance monitoring program

5.5.6 Corrective Action Program [D-10g]

If, at a point of compliance (a well), dangerous constituents of concern are measured in the groundwater at concentrations that exceed the applicable groundwater concentration limit, Ecology must be notified in 7 days, and an application to modify the permit to include a corrective action plan must be sent to

Ecology within 90 days or within the time agreed to by Ecology. A description of the groundwater monitoring plan, including all additional corrective actions that are appropriate for a corrective action program will be prepared and submitted to Ecology when the need for corrective action first is identified.

This section has been identified as
"Official Use Only" (OUO)
and is available to view by appointment at
the Nuclear Waste Program
Resource Center
3100 Port of Benton
Richland, Washington.

Please contact Valarie Peery at
(509) 372-7920
for a viewing appointment.

Table 5-1. Water Levels in Groundwater Wells in the Vicinity of the IDF Site.

Well	Measure date	DTW m[a]	WT elev m[b]	Ref elev m[c]
299-E13-10	03/14/02	101.7	122.5	226.31
299-E17-12	03/14/02	100.0	121.1	221.09
299-E17-13	04/12/01	97.7	122.6	220.34
299-E17-17	04/12/99	97.8	122.8	220.54
299-E17-18	10/03/02	98.5	122.3	220.76
299-E17-20	04/09/97	97.1	123.2	220.33
299-E17-21	04/23/98	100.4	122.7	224.26
299-E17-22	05/20/02	98.1	122.5	220.59
299-E17-23	05/20/02	101.6	122.2	223.84
299-E17-25	05/21/02	98.3	126.7	225.03
299-E18-1	03/14/02	98.2	122.4	220.65
299-E18-3	06/27/96	97.8	123.4	221.20
299-E18-4	06/27/96	97.7	123.4	221.05
299-E19-1	03/22/88	100.4	124.9	225.26
299-E23-1	03/14/02	96.0	122.4	218.39
299-E23-2	12/20/94	97.2	123.5	220.77
299-E24-4	08/10/98	90.6	122.9	213.47
299-E24-7	06/11/97	96.2	123.2	219.34
299-E24-16	10/04/02	97.7	122.3	220.02
299-E24-17	04/07/97	97.36	122.9	220.16
299-E24-18	10/02/02	98.0	122.3	220.35
299-E24-21	03/22/01	95.4	122.6	217.85

[a] DTW = depth to water
[b] WT elev = elevation of water table (meters above mean sea level)
[c] Ref elev = reference elevation (meters above mean sea level, North American Vertical Datum 88 reference), generally top of well casing.

Table 5-2. Monitored Constituents for the IDF.

Indicator parameters	Supplemental constituents
Chromium (filtered)	Alkalinity
Specific conductance (field)	Anions
Total organic carbon	ICP metals
Total organic halides	Turbidity (field)
pH (field)	

Table 5-3. Expected Behavior of Selected Regulated Constituents/Materials for the IDF.

Constituent/material	Expected charged state	Expected mobility[1] (K_d)	Comments
Organics			
Acetonitrile	N/A	High (0.16)	Miscible with water (Howard Volume IV, 1993)
Carbon tetrachloride	N/A	High (0.60); 0.29 (DOE/RL-93-99)	Moderately soluble in water (805 mg/L) (Howard, Volume II,1990)
Creosote[2]	N/A	High (0.03 to 0.06)[3]	Relatively low solubility in water. Naphthalene solubility in water (31.7 mg/L [Howard, Volume 1, 1989]). Anthracene solubility in water (0.03 to 0.5 mg/L[Mackay et al, Volume II, 1992])
Dioxane	N/A	High (0.01)	Miscible with water (Howard, Volume II, 1990)
Ethylene glycol	N/A	Unknown[4]	Miscible with water (Howard, Volume II, 1990)
Naphthalene		Moderate (4 to 10); 1.4 (DOE/RL-93-99)	Sparingly soluble in water (31.7 mg/L [Howard, Volume I, 1989]).
Polychlorinated biphenyls	N/A	Low (20 to 100); 440 to 2,300 (DOE/RL-93-99)	Low solubility in water. 0.01 to 1 mg/L as Aloclors (Mackay et al. 1992); 0.27 to 1.45 mg/L (WHC-SD-EN-TI-201)
Tetrachloroethylene	N/A	High (2.1); 0.22 (DOE/RL-93-99)	Moderately soluble in water (1,503 mg/L) (Howard, Volume II, 1990)
Toluene	N/A	High (0.37 to 1.8); 0.18 (DOE/RL-93-99)	Moderately soluble in water (535 mg/L) (Howard, Volume II, 1990)
Trichloroethylene	N/A	High (1.0); 0.1 to 1.0 (WHC-SC-EN-TI-201); 0.11 (DOE/RL-93-99)	Moderately soluble in water (1,100 mg/L) (Howard, Volume II, 1990)
Vinyl chloride	N/A	High (0.004); 0.056 (DOE/RL-93-99)	Moderately soluble in water (2,763 mg/L) (Howard, Volume I, 1989)
Inorganics			
Antimony	Cation (Sb^{+2})	Moderate (0 to 40, best estimate: 20 [DOE/RL-93-99])	Moderately soluble (best estimate): 1,000 mg/L (DOE/RL-93-99)
Arsenic	Anion (AsO_4^{-5})	High , 0 (DOE/RL-93-99)	Moderately soluble (best estimate): 1,000 mg/L (DOE/RL-93-99)
Barium	Cation (Ba^{+2})	Moderate, 20 to 200, best estimate: 50 (DOE/RL-93-99)	Low solubility (best estimate): 1 mg/L (DOE/RL-93-99)
Beryllium	Cation (Be^{+2})	Moderate, 15 to 200, best estimate: 20 (DOE/RL-93-99)	Solubility unknown. Best estimate: 1 mg/L
Cadmium	Cation (Cd^{+2})	Moderate, 15 to 30, best estimate: 23 (DOE/RL-93-99)	Sparingly soluble. Best estimate: 25 mg/L (DOE/RL-93-99)
Chromium	Anion (CrO_4^{-2})	High (0.0 to 1.02 [PNNL-13895]; 0.001 (WHC-SC-EN-TI-201)	Low solubility: 0.5 to 10 mg/L (WHC-SC-EN-TI-201)
Lead	Cation (Pb^{+2})	Low (1,330 to 469,000 [PNNL-13895])	Low solubility: 287 µg/L in Hanford Site groundwater (PNL-9791)
Mercury	Cation (Hg^{+2})	Moderate, best estimate: 30 (DOE/RL-93-99)	Solubility unknown. Best estimate: 1 mg/L (DOE/RL-93-99)

Table 5-3. Expected Behavior of Selected Regulated Constituents/Materials for the IDF.

Constituent/material	Expected charged state	Expected mobility[1] (K_d)	Comments
Nickel	Cation (Ni^{+2}) Ni $(OH)_2$ $NiCO_3$	Low (48 to 337 [PNNL-13895)	Low solubility: 1.9 mg/L in Hanford Site groundwater (PNL-9791)
Selenium	Anion (SeO_4^{-6})	High (3 to 10 [PNNL-13895]) (3 to 8 PNNL-11966)	Moderately soluble. Best estimate: 1,000 mg/L (DOE/RL-93-99)
Silver	Cation (Ag^+)	Moderate, 20 to 30, best estimate: 25 (DOE/RL-93-99)	Sparingly soluble (best estimate): 25 mg/L (DOE/RL-93-99).

N/A = Not applicable

[1] Unless cited in the column, K_d (partition coefficient) values were calculated from K_{oc} (normalized sorption coefficient) values obtained from either the Handbook of Environmental Fate and Exposure Data for Organic Chemicals series (Volumes I-IV) (P.H. Howard, ed) or the Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals series [Mackay et al. 1992a, 1992b]. For all organics (except carbon tetrachloride), the calculation assumes an organic carbon content for Hanford Site soil of 1.0%. The value of organic carbon assumed is conservative recognizing that the organic carbon content of most Hanford Site soil falls considerably below this value. However, applying this level of conservatism also recognizes that mineral-driven sorption likely plays a role in organic constituent mobility for Hanford Site soils with organic carbon content at or below 0.1% (PNNL-13560). A calculation of a K_d value using acetonitrile as an example is as follows. The literature estimated value of K_{oc} for acetonitrile is 16 (Howard 1993).

$K_d = f_{oc} \text{ X } K_{oc}$ where f_{oc}= the mass fraction of organic carbon in the soil.

K_d (acetonitrile) = 0.01 X 16 = 0.16.

[2] Creosote is a coal tar distillate containing high quantities of naphthalene and anthracene (Lewis, R.J., Sr. 1993).

[3] Because creosote is predominately a mixture of naphthalene and anthracene (footnote 2), assumed K_{oc} values for naphthalene (Howard 1989) and anthracene (Mackay et al., Volume II) in calculating a K_d range for creosote.

[4] This constituent has a low octanol/water partition coefficient indicating that its adsorption to soil would be low (Howard, Volume II, 1990)

Table 5-4. Analytical Methods and Method Detection Limits for Regulated Constituents and Indicator Parameters.

Class of Compounds	Analytical Methods	Method Detection Limit[2] (ug/L)
Metals		
	SW 846, Method 6010 (ICP metals)	0.18 - 51[1]
	SW 864, Method 7060 (Arsenic)	1
	SW 846, Method 7131 (Cadmium)	0.1
	SW 846, Method 7191 (Chromium)	1
	SW 846, Method 7421 (Lead)	1
	SW 846, Method 7470 (Mercury)	0.2
	SW 846, Method 7740 (Selenium)	2
	SW 846, Method 7841 (Thallium)	1
Semi-Volatile Organics		
	SW 846, Method 8041	Not available
	SW 846, Method 8270	10 - 1000[1]
Pesticides/Polychlorinated Biphenyls		
	SW 846, Method 8081 (Pesticides)	Not available
	SW 846, Method 8082 (PCBs)	0.005 – 0.025[1]
Herbicides		
	SW 846, Method 8151	0.02 – 1.3[1]
Volatile Organic Compounds		
	SW 846, Method 8260 (VOAs)	0.01 - 57[1]
	SW 846, Method 8021 (Halogenated VOAs)	0.003 - 3[1]
Dioxins		
	SW 846, Method 8280	0.01 - 0.05[1]
General Chemistry		
	SW 846, Method 9012 (Cyanide)	Not available
	SW 846, Method 9010 (Cyanide)	20
	SW 846, Method 9030 (Sulfide)	200 - 400[1]
Alkalinity		
	EPA-600/4-79-020, Method 310.1	Not available
Anions		
	EPA-600/R-93-100, Method 300.0	2 – 2-[1]
pH		
	Company specific	Not applicable
Specific conductance	SW 846, Method 9050	Not available

1. Detection limit varies according to specific compound. The range of contract required detection limits for all compounds detected by the specific analytical method is given.
2. Method detection limits are from SW846 and EPA Methods, not the detection limits required by contract with the analytical laboratories.

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Code of Federal Regulations

40 CFR 136.3 (5.5.4.1) Code of Federal Regulations, Title 40, Part 136. Whole Effluent Toxicity: Guidelines Establishing Test Procedures for Chemical Analysis of Pollutants.

40 CFR 264, Code of Federal Regulations, Title 40, Part 264, Subpart F. Standards for Owners of Hazardous Waste Treatment, Storage, and Disposal Facilities.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 6.0 Procedures to Prevent Hazards

Figure

Tables

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

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Integrated Disposal Facility

Chapter 7.0 **Contingency Plan**

Appendix

Table

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7.0 CONTINGENCY PLAN [G]

The WAC 173-303 requirements for a contingency plan are satisfied in the following documents: portions of the *Hanford Emergency Management Plan* [Attachment 4 of the HF RCRA Permit (DW Portion)] and portions of the *Building Emergency Plan for the Integrated Disposal Facility* (Appendix 7A).

The unit-specific building emergency plan also serves to satisfy a broad range of other requirements [e.g., Occupational Safety and Health Administration standards (29 CFR 1910), *Toxic Substance Control Act of 1976* (40 CFR 761) and U.S. Department of Energy Orders]. Therefore, revisions made to portions of this contingency plan document that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to WAC 173-303-830 or HF RCRA Permit (DW Portion) Condition I.C.3.

Table 7-1 identifies which portions of the building emergency plan are written to meet WAC 173-303 contingency plan requirements. In addition to the building emergency plan portions identified in Table 7-1, Section 12.0 of the building emergency plan is written to meet WAC 173-303 requirements identifying where copies of the *Hanford Emergency Management Plan* and the building emergency plan are maintained on the Hanford Facility. Therefore, revisions to Section 12.0 and the portions identified in Table 7-1 are considered a modification subject to WAC 173-303-830 or the HF RCRA Permit (DW Portion), Condition I.C.3.

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Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Hanford Emergency Management Plan (DOE/RL-94-02): Attachment 4 of the HF RCRA Permit (DW Portion)	Building Emergency Plan[1] ***(ILAW Document Number)***
-350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360.	X[2] Section 1.3.4	X[2] Sections 7.1, 7.2 through 7.2.5, and 7.3[3] Sections 4.0, 8.2, 8.3, 8.4, 11.0
-350(3)(b) - A description of the actions which shall be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported pursuant to the requirements of WAC 173-303-370(5), Manifest system, reasons for not accepting dangerous waste shipments.	X[2] Section 1.3.4	X[2,4] Section 7.2.5.1
-350(3)(c) - A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4).	X Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3-1	
-350(3)(d) - A current list of names, addresses, and phone numbers (office and home) of all persons qualified to act as the emergency coordinator required under WAC 173-303-360(1). Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. For new facilities only, this list may be provided to the department at the time of facility certification (as required by WAC 173-303-810 (14)(a)(I)), rather than as part of the permit application.		X[5] Section 3.1, 13.0
-350(3)(e) - A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.	X Hanford Fire Department: Appendix C	X Section 9.0

Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Hanford Emergency Management Plan (DOE/RL-94-02): Attachment 4 of the HF RCRA Permit (DW Portion)	Building Emergency Plan[1] (*ILAW Document Number*)
-350(3)(f) - An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes.	X[6] Figure 7-3 and Table 5-1	X[7] Section 1.5

An 'X' indicates requirement applies.

[1] Portions of the *Hanford Emergency Management Plan* not enforceable through Appendix A of that document are not made enforceable by reference in the building emergency plan.

[2] The *Hanford Emergency Management Plan* contains descriptions of actions relating to the Hanford Site Emergency Preparedness System. No additional description of actions are required at the site level. If other credible scenarios exist or if emergency procedures at the unit are different, the description of actions contained in the building emergency plan will be used during an event by a building emergency director.

[3] Sections 7.1, 7.2 through 7.2.5, and 7.3 of the building emergency plan are those sections subject to the Class 2 "Changes in emergency procedures (i.e., spill or release response procedures)" described in WAC 173-303-830, Appendix I Section B.6.a.

[4] This requirement only applies to TSD units that receive shipments of dangerous or mixed waste defined as offsite shipments in accordance with WAC 173-303.

[5] Emergency Coordinator names and home telephone numbers are maintained separate from any contingency plan document, on file in accordance with HF RCRA Permit (DW Portion) General Condition II.A.4. and are updated, at a minimum, monthly.

[6] The Hanford Facility (sitewide) signals are provided in this document. No unit/building signal information is required unless unique devices are used at the unit/building.

[7] An evacuation route for the TSD unit must be provided. Evacuation routes for occupied buildings surrounding the TSD unit are provided through information boards posted within buildings.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

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Chapter 13.0 **Other Federal and State Laws**

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8.0 PERSONNEL TRAINING [H]

This chapter discusses personnel training requirements based on WAC 173-303 and the HF RCRA Permit (DW Portion). The HF RCRA Permit (DW Portion), Condition II.C (Personnel Training), contains training requirements applicable to Hanford Facility personnel and non-Facility personnel. Compliance with these requirements at the IDF is demonstrated by information contained both in Chapter 8.0 of DOE/RL-91-28, Attachment 33 of the HF RCRA Permit, and this chapter. This chapter supplements Chapter 8.0 of DOE/RL-91-28.

8.1 OUTLINE OF INTRODUCTORY AND CONTINUING TRAINING PROGRAMS [H-2]

The introductory and continuing training programs are designed to prepare personnel to manage and maintain the TSD unit in a safe, effective, and environmentally sound manner. In addition to preparing personnel to manage and maintain TSD units under normal conditions, the training programs ensure that personnel are prepared to respond in a prompt and effective manner should abnormal or emergency conditions occur. Emergency response training is consistent with the description of actions contained in Chapter 7.0, "Contingency Plan".

Introductory training includes general Hanford Facility training and TSD unit-specific training. General Hanford Facility training is described in DOE/RL-91-28, Section 8.1, and is provided in accordance with the HF RCRA Permit (DW Portion), Condition II.C.2. TSD unit-specific training is provided to Hanford Facility personnel allowing personnel to work unescorted. Hanford Facility personnel cannot perform a task for which they are not properly trained, except to gain required experience while under the direct supervision of a supervisor or coworker who is properly trained. Hanford Facility personnel assigned the job title of Emergency Coordinator and alternates to this position performing tasks described in WAC 173-303-360 (e.g., Building Emergency Directors) are thoroughly familiar with applicable contingency plan documentation, operations, activities, location, and properties of all waste handled, location of all records, and the unit/building layout.

Continuing training meets the requirements for WAC 173-303-330(1)(b) and includes general Hanford Facility training and TSD unit-specific training. General Hanford Facility training is the same as described for introductory training. TSD unit-specific training provides an annual review of emergency response training and an annual review of training necessary to ensure TSD unit operations are in compliance with WAC 173-303.

8.2 DESCRIPTION OF TRAINING PLAN

In accordance with HF RCRA Permit (DW Portion), Condition II.C.3, the unit-specific portion of the *Hanford Facility Dangerous Waste Permit Application* must contain a description of the training plan. The plan is written to comply with WAC 173-303-330 and is found in Appendix 8A. Written training plan documentation is maintained outside of the *Hanford Facility Dangerous Waste Permit Application* and the HF RCRA Permit. Therefore, changes made to the written training plan documentation are not subject to the HF RCRA Permit modification process. The training plan will be maintained as part of the operating records of the facility and will be available to regulators upon request.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS
OPERATING UNIT 11
Integrated Disposal Facility

Chapter 8.0 **Personnel Training**

Appendix

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

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Appendix 8A **Dangerous Waste Training Plan**

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CH2M HILL Hanford Group, Inc.	**Manual**	**Management Plan**
	Document	**IDF-PLN-07, REV A-2**
DANGEROUS WASTE TRAINING PLAN	**Page**	**1 of 10**
	Issue Date	**May 14, 2003**
	Effective Date	**May 26, 2003**

FUNCTIONAL AREA MANAGER: **P.C.Miller**

DOCUMENT OWNER: **S. A. Davis**

1.0 PURPOSE AND SCOPE

This document outlines the dangerous waste training plan (DWTP) developed for the Integrated Disposal Facility(IDF) operated by the River Protection Project (RPP) Tank Farms Contractor

This plan applies to IDF personnel employed by the CH2M HILL Hanford Group, Inc., the visitors CH2M HILL Hanford Group, Inc. brings onto the Hanford facility, and any subcontractors conducting work on behalf of CH2M HILL Hanford Group, Inc. The Hanford facility constitutes the Hanford site as defined by the Hanford facility Resource Conservation and Recovery Act (RCRA) permit issued by Ecology.

2.0 RESPONSIBILITIES

2.1 Management

The waste management facility manager has overall responsibility for training at the IDF under his control that includes but is not limited to: (5.1.1)

- Determine training requirements and training compliance for Hanford facility personnel, subcontractors, and visitors who obtain access or work within the IDF unit.
- Identify training requirements to contractors working in or around IDF units.

2.2 Training Manager

- Ensure instructors have satisfactory instructional skills and are technically knowledgeable through: current qualification/certification or specialized training, license/certificate or a degree in the technical area, or other appropriate training or experience (see DOE/RL-91-28 Chapter 8.0). (5.1.1)
- Conduct informal job analysis and identify training commensurate with personnel duties and responsibilities.
- Design and develop training programs.
- Develop and instruct training courses.
- Develop and maintain On-The-Job training requirements.
- Maintain the RPP-IDF training records.

2.3 Environmental Organization Responsibilities:

- Consult with training organization and IDF management in the development and evaluation of current training programs.

- Assist IDF manager in determining training requirements and RCRA compliance for personnel.

- Maintain current knowledge of RCRA training requirements pertaining to Hanford facility personnel.

2.4 Contracted Services (e.g., Fluor Federal Services (FFS) and Waste Management)

Contracted personnel who are classified as Hanford facility personnel have the following responsibilities:

- Ensure that employees are trained to meet RPP-IDF training requirements.
- Maintain employee training records and provide them if requested by RPP-IDF.

2.5 CH2M HILL Waste Services Responsibilities

- Provide daily Federal Register review, regulatory interpretation, and application of DOT regulations. As new requirements are identified, this information is distributed to the HAZMAT employees

- Maintain the authorized shippers list by reviewing shippers' qualifications through training records and verifying receipt of "request for authority" forms signs by requestor's management. This list is updated and distributed monthly

- Maintain a database, tracks shipping activities, and changes to the authorized shipper's list

- Conduct DOT compliance verification inspection and verification on HAZMAT, HW, RAM, and RMW shipments

- Provide information to training records regarding course completion.

3.0 PROCESS

3.1 Training Program

The introductory and continuing training programs are designed to prepare employees to operate and maintain the tank farms in a safe, effective, efficient, and environmentally sound manner. In addition to preparing employees to operate and maintain the tank farms under normal conditions, the training program ensures that employees are prepared to respond in a prompt and effective manner should abnormal or emergency conditions occur.

Introductory training includes general Hanford facility training and TSD unit-specific training.

General Hanford facility training is described in DOE/RL-91-28, Section 8.0, and provided in accordance with the Hanford Facility RCRA Permit (DW Portion), Condition II.C.

TSD unit-specific training is provided to Hanford facility personnel, allowing personnel to work unescorted and, in some cases, is required for escorted access. Hanford facility personnel cannot perform a task for which they are not properly trained, except to gain required experience while under the direct supervision of a supervisor or coworker who is properly trained.

The IDF Dangerous Waste training program is implemented. Incumbent personnel will complete new requirements within six months of the requirements being identified. Training of new employees is completed within the first six months of assignment. Training for personnel assigned to new positions is completed within six months of reassignment. Personnel who have not completed training are permitted to work at the IDF only under the supervision of a trained employee. IDF operations management is responsible for ensuring that personnel are trained and required qualifications are maintained. (5.1.3)

Continuing training meets the requirements for WAC 173-303-330(1)(b) and includes general Hanford facility training and TSD unit-specific training. (5.1.2)

3.2 Emergency Response Training

Federal and state regulations require that personnel be able to respond effectively to emergencies. In accordance with WAC 173-303-330(1)(d), personnel are trained on aspects applicable to operations. The following table indicates requirements from WAC 173-303-330(1)(d) applicable to IDF operations. (5.1.1, 5.1.4)

Elements of WAC 173-303-330(1)(d)	Applicability to TSD Units (1) and < 90-day Accumulation Areas (2)	
	(1)	(2)
Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment	YES	YES
Key parameters for automatic waste feed cut-off systems	YES	NO
Communications or alarm systems	YES	YES
Response to fires or explosions	YES	YES
Response to groundwater contamination incidents	YES	YES
Shutdown of operations	YES	YES

3.3 Dangerous Waste Worker Categories

Employee duties at the IDF are categorized within four worker categories. In the event personnel duties and responsibilities overlap between categories, the employee will complete the training requirements for each category. These categories are: (5.1.1, 5.1.5)

1. All Employees

2. Waste Worker
3. Advanced Waste Worker
4. Waste Worker Supervisor/Manager

Each employee is assigned a job title (from salaried nonexempt or bargaining unit classifications) or position (from exempt classifications). Job or position descriptions include requisite skills, work experience, education and other qualifications, and a list of duties and/or responsibilities for each job title or position. The work experience, education, and other qualifications required for each position are maintained by IDF Human Resources. As a minimum, "all employees" require a high school diploma or equivalent. Personnel filling exempt, management, or engineering positions normally require a college degree with two or more years of industry experience. (5.1.5)

Only names of Hanford facility personnel who carry out job duties relating to TSD unit waste management operations at IDF are maintained. Names are maintained in electronic data storage within the Integrated Training Electronic Matrix (ITEM). A list of Hanford facility personnel assigned to IDF is available upon request.

In the following sections, brief job titles and position descriptions of employees associated with dangerous waste management at IDF are listed within the appropriate waste worker category. (5.1.5)

3.3.1 All Employees

Hanford facility personnel included in this position are not categorized into one of the other three worker positions. Non-Hanford facility personnel included within this position are those personnel that require access to portions of the Hanford facility not accessible to the public.

Personnel in the "all employees" position are prohibited from performing duties or responsibilities associated with the management of waste in accumulation/storage containers on the Hanford facility. These personnel have the responsibility to report spills and releases that they discover in addition to taking any evacuation or take cover actions in response to specific incidents that may occur.

Most of the Hanford facility personnel categorized as "all employees" will be administrative and technical/professional personnel which include secretaries, clerks, and support organizations who perform walk-downs or provide oversight. Most non-Hanford facility personnel will be categorized as "all employees" since these personnel generally tour, provide oversight, or are brought on the Hanford facility for interviews. Other non-Hanford facility personnel who gain access to the Hanford facility to complete work in controlled areas that will not directly involve the management of dangerous or mixed waste, will be categorized as "all employees."

All employees are required to complete Hanford General Employee Training (HGET) with an annual refresher (HGET core).

3.3.2 Waste Workers

Hanford facility personnel or non-Hanford facility personnel with waste management duties and responsibilities who require unescorted access and are limited to the initial generation of dangerous or mixed waste and placing that waste into a pre-approved container, or who conduct dangerous or mixed waste inspections, are categorized as waste workers.

The pre-approved container can include those in a satellite accumulation area, <90-day accumulation area, or temporary storage and disposal unit.

These personnel could generate dangerous or mixed waste while working on a non-RCRA system (e.g., building maintenance) or working on a temporary storage and disposal unit when conducting maintenance. These personnel could also include operators who conduct daily inspections on tank systems to ensure they are operating properly, and operators who conduct daily inspections on ancillary equipment.

The work may be unsupervised or completed under the supervision of qualified unit/building personnel (e.g., the person in charge or field work supervisor). In addition, a waste worker must fulfill the roles of an "all employee." Hanford facility personnel categorized as waste workers may be assigned duties and responsibilities for:

- Placing waste they generate into pre-approved containers and filling out log sheets, where applicable

- Completing radiological surveys of dangerous or mixed waste

- Loading packaged containers onto trucks or movement of containers

- Responding to a spill or release of known contents where the duties and responsibilities are limited to containing the spill/release, returning the drum to an upright position, and placing the known spilled material or waste into a pre-approved container

- Applying container markings or labels based on direction received from others

- Responding to regulatory agency compliance inspectors' questions about waste management practices

- Performing an inventory of dangerous or mixed waste

- Conducting inspections of dangerous or mixed waste.

Personnel who function as waste workers may include, but are not limited to, the following:

- Maintenance and craft personnel
- Operators
- Health physics technicians
- Transporters
- Contractor crafts
- Technical support staff.

The list of employees currently filling this position is maintained by the ITEM.

3.3.3 Advanced Waste Worker

Hanford facility personnel are categorized as advanced waste workers if their duties and responsibilities concerning dangerous or mixed waste exceed that of waste workers (therefore, an advanced waste worker may fulfill the roles of a waste worker.) Examples of these duties and responsibilities can include determining container markings, sampling of waste, designation of waste material(s), and classification of waste materials prior to shipment.

The list of employees currently filling this position is maintained by the ITEM.

3.3.4 Waste Worker Supervisor/Manager

Various types of managers and non-managers are included in this position. Hanford facility personnel assigned to unit/buildings can be categorized as waste worker supervisor/managers if they direct waste worker or advanced waste worker activities relating to dangerous waste management and compliance activities. Managers and non-managers who direct waste workers and advanced waste workers have many similar duties and responsibilities relating to dangerous or mixed waste management and are required to take the same courses.

The following staff has duties and responsibilities that meet this description:

- Emergency coordinator and/or alternate(s) (e.g., building emergency directors and some building wardens)
- Environmental Compliance Officer and Waste Management manager for IDF
- Immediate managers of waste workers and advanced waste workers (e.g., field work supervisors, Radiological Control first-line managers and operations engineers/managers).

The list of employees currently filling this position is maintained by the ITEM.

3.4 Matrix of Training Requirements for Each Waste Worker Category

The following training requirements are maintained in the ITEM. Based on training assessments, oversight, and acting within federal and state regulations, IDF management may change the training requirements. For this reason, a current course listing is available upon request.

Course descriptions with retrain frequencies are linked to the courses in the ITEM. Continuing training (retraining) courses are linked in the ITEM database to the initial training course. If the continuing training is not kept current, the system will show the initial course as delinquent. (5.1.5)

3.4.1 All Employees

NOTE: Select link for course description (5.1.5)

000001

HANFORD GENERAL EMPLOYEE TRAINING - FULL

3.4.2 Waste Worker

[ ] Option 01 Waste Worker Core, Individual performs duties as a Waste Worker at the River Protection Project Tank Farms Contractor.

000001	HANFORD GENERAL EMPLOYEE TRAINING - FULL
03E060	RPP/TANK FARM FACILITY EMERGENCY HAZARDS CHECKLIST
350560	RPP WASTE HANDLING, SEGREGATION AND PACKAGING
XXXXX	Integrated Diposal Facility Orientation

[ ] Option 02 The course covers federal, state and company policy regarding the management of containerized waste, both regulated (dangerous) and non-regulated.

035100	CONTAINER WASTE MANAGEMENT INITIAL

3.4.3 Advanced Waste Worker

[ ] Option 01 Advanced Waste Worker Core, Individual performs duties as an Advanced Waste Worker at the RPP Tank Farms Contractor.

000001	HANFORD GENERAL EMPLOYEE TRAINING - FULL
035100	CONTAINER WASTE MANAGEMENT INITIAL
03E060	RPP/TANK FARM FACILITY EMERGENCY HAZARDS CHECKLIST
350560	RPP WASTE HANDLING, SEGREGATION AND PACKAGING
XXXXXX	Integrated Diposal Facility Orientation

[ ] Option 02 Waste Designator, Individual performs Waste Designation duties at the RPP Tank Farms Contractor

035010	WASTE DESIGNATION
035012	WASTE DESIGNATION QUALIFICATION
035020	FACILITY SAMPLING AND ANALYSIS

[ ] Option 03 Hazardous Waste Shipper, Individual performs Hazardous Waste Shipping duties at the RPP Tank Farms Contractor. Note: Need to select Option 04 "Radioactive Materials Shipper" if Individual will be performing duties as a "Mixed Waste Shipper".

020159	ADVANCED COURSE 2 - HAZARDOUS WASTE SHIPPER CERTIFICATION TRAINING

[ ] Option 04 Radioactive Materials Shipper, Individual performs Radioactive Material Shipping duties at

the RPP Tank Farms Contractor. Note: Need to select Option 03 "Hazardous Waste Shipper" if Individual will be performing duties as a "Mixed Waste Shipper".

020069 ADVANCED COURSE 3 - RADIOACTIVE MATERIALS SHIPPER CERTIFICATION TRAINING

3.4.4 Waste Worker Supervisor/Manager

[ ] Option 01 Waste Worker Supervisor/Manager Core, Individuals that direct Waste Worker or Advanced Waste Worker activities relating to dangerous or mixed waste management and compliance activities.

- 000001 HANFORD GENERAL EMPLOYEE TRAINING - FULL
- 035050 ENVIRONMENTAL REGULATIONS AT HANFORD (CLASSROOM)
- 03E060 RPP/TANK FARM FACILITY EMERGENCY HAZARDS CHECKLIST
- 350560 RPP WASTE HANDLING, SEGREGATION AND PACKAGING
- XXXXXX Integrated Diposal Facility Orientation

[ ] Option 02 Waste Shipper/Supervisor, Individual performs Waste Shipping / Supervision duties at the RPP Tank Farms Contractor

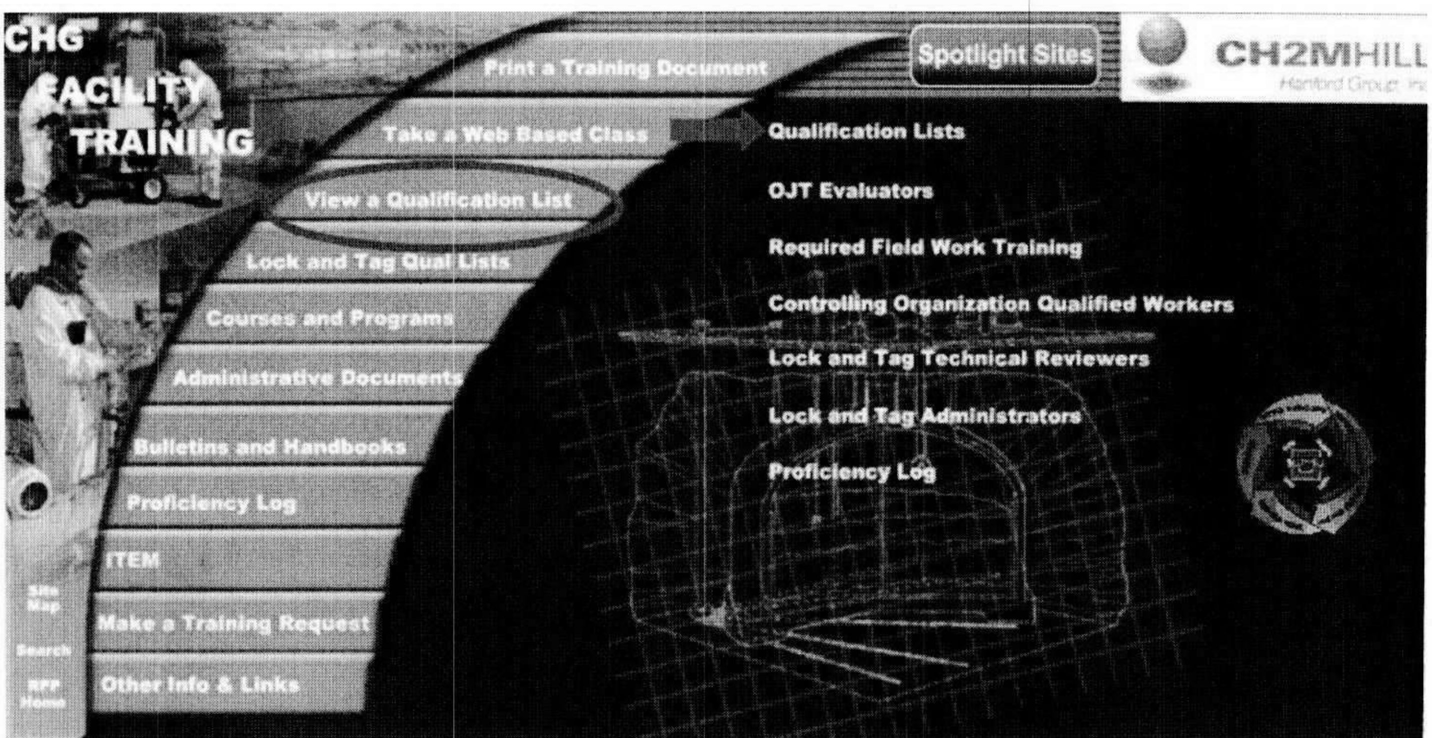
- 020078 ADVANCED COURSE 4 - MIXED WASTE SHIPPER CERTIFICATION TRAINING
- 020159 ADVANCED COURSE 2 - HAZARDOUS WASTE SHIPPER CERTIFICATION TRAINING
- 035100 CONTAINER WASTE MANAGEMENT INITIAL

[ ] Option 03 Waste Designator/Supervisor, Individual performs Waste Designation / Supervision duties at the RPP Tank Farms Contractor

- 035010 WASTE DESIGNATION
- 035012 WASTE DESIGNATION QUALIFICATION
- 035020 FACILITY SAMPLING AND ANALYSIS

3.5 Job-Specific Facility Training

The IDF-specific and job-specific qualifications and/or certifications are maintained according to contractual and regulatory requirements. IDF management uses qualification lists to ensure personnel they assign to work in the tank farms meet current training requirements. The qualification lists, generated using the PeopleSoft® database, are updated on a daily basis and are posted to the IDF Training Web Page.



3.6 Training Records

Training records, as described in WAC 173-303-330, consist of documentation that show training has been completed. Training records associated with personnel identified in the DWTP are maintained in accordance with DOE/RL-91-28 Chapter 8.0. Hanford Facility training records include both electronic data storage and hard copies. Course completion documentation for personnel is maintained in both hard copy and electronic formats. (5.1.5)

The course completion documentation will contain the course number, course title, and date of completion. Copies of the training record files for IDF Dangerous Waste management employees are stored at IDF Training. The originals are sent to Fluor Hanford, Inc. (FH) Training and are initially maintained in Richland, Washington. Original hard copy training records are transferred periodically to the Records Holding Facility in Richland, Washington. After approximately one year, the original hard copy training records are archived at the permanent record storage center in Renton, Washington. Course completion documentation of former employees are maintained in accordance with DOE/RL-91-28 Chapter 8.0 and Hanford Facility RCRA Permit, General Facility Condition II.I.1, Regarding Facility Operations Record.

When a training record is requested during an inspection, an electronic data storage record will initially be provided. If the electronic data storage record does not satisfy the inspection concern, a hard copy training record will be provided. Training records of former employees may not be available through computers at IDF and may require a representative from FH Training to access the PeopleSoft® system for this information.

4.0 DEFINITIONS

No terms or phrases unique to this procedure are used.

5.0 SOURCES

5.1 Requirements

1. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1) and (1)(a), Personnel Training. (S/RID)
2. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1)(b). (S/RID)
3. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1)(c). (S/RID)
4. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(1)(d). (S/RID)
5. WAC 173-303-330 "Dangerous Waste Regulations," Section 330(2). (S/RID)

5.2 References

1. 40CFR265.16, "Protection of Environment, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Personnel Training.
2. DOE/RL-91-28 Rev 4, "Dangerous Waste Portion Of The Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste," Chapter 8, Personnel Training.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 11.0 **Closure and Financial Assurance**

Figure

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11.0 CLOSURE AND FINANCIAL ASSURANCE [I]

This chapter discusses preclosure, closure, and postclosure activities for the IDF. This closure plan complies with WAC 173-303-610 and represents the baseline for closure.

The IDF will be constructed on 25 hectares of vacant land southwest of the PUREX Plant in the 200 East Area (Figure 2-1). The landfill will be segregated into a RCRA permitted side and a non-RCRA permitted side. The scope of this permit application is limited to the western side of the landfill where the RCRA waste will be placed. The waste containers and bulk waste that meet the IDF waste acceptance criteria will be inventoried, and disposed in this lined landfill. Leachate collected from the lined landfill will be transferred to leachate collection tanks located in proximity to the landfill for subsequent treatment.

A more detailed discussion of IDF waste types and the identification of the IDF processes and equipment are provided in Chapters 3.0 and 4.0, and attendant appendices. The IDF only will accept and dispose waste containers and bulk waste that meet the IDF waste acceptance criteria, RCRA and LDR.

The closure process will be the same for partial closure or closure of the entire IDF. The remainder of this chapter describes the performance standards that will be met, and the closure/postclosure activities that will be conducted.

Federal facilities are not required to comply with WAC 173-303-620 as is stated in the regulations and as described in Condition II.H.3. of the *Dangerous Waste Portion of the Hanford Facility RCRA Permit* (Ecology 2001).

11.1 CLOSURE PLAN [I-1]

Waste containers and bulk waste that meet the IDF waste acceptance criteria will be disposed in the lined landfill that complies with WAC 173-303-665 standards (Chapter 4.0). The IDF will be closed according to current applicable WAC 173-303 regulations, DOE requirements, best management practices, and will be integrated with the overall cleanup activities performed under the Tri-Party Agreement (HFFACO 2001).

The disposal landfill cover will be designed and located to comply with WAC 173-303-665(6) and WAC 173-303-610. The specification and/or variation for other cover designs will be provided at the time of closure once a hazard(s) has been defined.

11.2 CLOSURE PERFORMANCE STANDARDS [I-1a]

Closure requirements found in DOE/RL-91-28, Chapter 11.0, combined with requirements found in WAC 173-303-665(6), will make up the closure performance standards for the IDF.

11.3 PRECLOSURE ACTIVITIES

Preclosure activities could include, at a minimum, placing interim or final covers over the filled portions of the landfill as the landfill is expanded to accept more waste. Placement of covers over the filled portions might be deferred until closure of all the IDF. Once a decision is made to construct the final cover over the landfill, a closure cover design will be used that satisfies the dangerous waste disposal requirements defined in WAC 173-303.

The selection of a final cover design has not been identified. Figure 11-1 shows an example of a typical Hanford Site landfill cover design. Design(s) will include features to satisfy the minimum requirements found in WAC 173-303-665(6).

11.4 MAXIMUM EXTENT OF OPERATION [I-1b(1)]

The maximum process design capacity of the IDF conservatively is calculated to be 100 hectare-meters, which is 1,000,000 cubic meters (Chapter 1.0, Part A, Form 3, Section III). The IDF landfill will be segregated into a RCRA permitted side of 50 hectare-meters and a non-RCRA permitted side of 50 hectare-meters.

11.5 DECONTAMINATING EQUIPMENT AND STRUCTURES

All ancillary equipment and its secondary containment, and instrumentation (e.g., level-indicating devices, leak detection devices, pumps, piping) meet the definition of "debris" as defined in WAC 173-303-040. Items in direct contact with mixed waste are assumed to meet the definition of "hazardous debris" as defined in WAC 173-303-040.

Currently, three options are available for treating hazardous debris. The first option is to treat the debris using one of the three debris treatment technologies-extraction, destruction, or immobilization-as described in 40 CFR 268.45. If the hazardous debris is treated using approved extraction or destruction technologies, the debris is no longer required to be managed as a dangerous waste as long as the debris does not exhibit a characteristic of a dangerous waste. If hazardous debris contaminated with a listed waste is treated using an immobilization technology, it remains a listed waste, even after the LDR treatment standards are met unless Ecology makes a case-by-case determination that the debris "no longer contains" a mixed waste. In effect, by making this "contained-in" determination on a case-by-case basis, Ecology will be setting clean closure standards in accordance with the closure performance standards of WAC 173-303-610(2)(a)(ii).

The second option is to treat the hazardous debris to meet the constituent-specific LDR treatment standard for the waste or waste-specific constituents contaminating the debris; however, such debris, even after treatment, may be considered a dangerous waste under the dangerous waste regulations and may require management at a facility permitted to manage dangerous waste.

The third option involves obtaining a "contained-in determination" for the hazardous debris, thereby rendering the waste "non-hazardous" for those waste-specific listed constituents that fall below MTCA method B risk-based health limits. Moreover, it must be proven that the debris does not designate as a characteristic waste under WAC-173-303.

11.5.1 CONTAMINATED SOIL

Contaminated soil could be generated as a result of spill cleanup. Since the majority of IDF operations will be preformed within secondary containment (see Chapters 4.0 and 6.0) the potential for spilling dangerous waste into the surrounding soil is low. Contaminated soil generated as a result of a dangerous waste spill will be managed pursuant to WAC-173-303-200.

Once the soil is designated, appropriate treatment and disposal or storage options will be determined and implemented.

A contained-in determination could also be sought for contaminated soil generated as a result of a spill. For contaminated media the contained-in policy requires that a statistically based sampling plan be used for obtaining the data to support a contained-in demonstration. The contained-in policy does not require that the waste be analytically nondetectable for it to be considered non-dangerous. However, the analytical results must prove that the listed constituents in the soil are below health-based limits as provided in WAC 173-303-610(2)(b)(i) and that the soil does not exhibit any dangerous waste characteristics (i.e., soil does not designate for D codes). If approved by Ecology, this could allow waste that falls below specific health-based levels to be disposed of without requiring treatment

11.6 CLOSURE OF LANDFILL UNITS [I-1e and I-1e(2)]

Closure of the IDF will be consistent with the closure requirements specified in WAC-173-303-665(6) and WAC 173-303-610. The cover design(s) will satisfy the requirements of WAC 173-303-665(6).

11.6.1 Cover Design [I-1e(2), I-1e(4), I-1e(5), I-1e(7), and I-1e(8)]

The cover could consist of several layers constructed on top of a native soil base. A generalized cross-section of an example cover is shown on Figure 11-1. It is assumed that before construction of the final cover, the waste form would be stabilized appropriately.

11.6.1.1 Grade Layer

The surface of the landfill would be graded and/or shaped, if necessary, to match the slope of the desired low-permeability layer. Additional soil would be placed over the landfill to achieve the required cover grade. This grade layer could taper from zero thickness near the edge of the cover boundary to perhaps several meters at the center of the cover; the thickness would depend on the lateral dimensions of the particular cover and the grade of the cover.

11.6.1.2 Low-Permeability Layer

The selection of an appropriate material for this layer would be based on the hazard that is to be isolated. The low-permeability layer will be the primary barrier in preventing soil and/or water from migrating into the waste zone and meet WAC 173-303-655 (6) (v) "Have a permeability less than or equal to the permeability of any bottom liner system or natural sub soils present".

11.6.1.3 Drainage Layer

The drainage layer would conduct any water that percolates through the overlying layers laterally to the drainage ditch. Thus, the drainage layer would prevent hydraulic pressure from building up directly on the low-permeability liner, and thereby eliminate one set of forces that would drive moisture through the primary moisture control barrier.

11.6.1.4 Plant, Animal, and Human Intrusion Layer (optional)

The performance objectives for the permanent isolation surface barrier are summarized as follows:

- Function in a semiarid to sub-humid environment
- Limit the recharge of water through the waste to near zero amounts [0.05 centimeter per year (1.6×10^{-9} centimeters per second)]
- Be maintenance free
- Minimize the likelihood of plant, animal, and human intrusion
- Limit the exhalation of noxious gases
- Minimize erosion-related problems
- Meet or exceed WAC 173-303-665(6) cover performance requirements

- Isolate waste for 1,000 years.

To satisfy the intrusion performance objective, an optional layer would be included in the design of barriers that require the additional human and/or biointrusion protection to reduce either the environmental or human health risk.

11.6.1.5 Graded Filter Layer

A graded filter consisting of crushed rock overlaid by sand would be placed on either the plant, animal, and human intrusion layer if incorporated into the design, or directly over the drainage layer. The graded filter would serve to separate the surface soil layer from the drainage layer. A geotextile would be placed on the top of the graded filter to decrease the potential for fine material to enter the filter and drainage zone. The geotextile would be permeable, allowing drainage, and would not support a standing head of water.

11.6.1.6 Surface Soil Layer

The two most important factors in engineering the surface soil thickness would be the assignment of the water retention characteristics for soil and climate information. Surface soil would be placed over the geotextile to intercept, store, and recycle water, and prevent damage to the underlying structure from natural and synthetic processes.

11.6.1.7 Vegetative Cover

The vegetative cover would perform three functions. First, the plants would return water stored in the surface soil back to the atmosphere, significantly decreasing net infiltration and reducing the amount of moisture available to penetrate the cover. Second, the vegetation would stabilize the surface soil component of the cover against wind and water erosion. Finally, the vegetative cover would restore the appearance of the land to a more natural condition and appearance.

A mixture of seeds would be used to establish vegetation. The seed types would be selected based on resistance to drought, rooting density, and ability to extract water.

11.6.2 Wind Erosion

The principal hazard associated with wind erosion is the thinning of the cover surface soil layer. This in turn potentially could lead to breaching of the moisture barriers, gradually allowing larger quantities of water to reach the waste. The engineering approaches to mitigating wind erosion of the cover would be (1) designing the surface soil layer with an appropriate total thickness to compensate for future soil loss that might result from wind erosion, (2) establishing a vegetative cover on the surface to reduce wind erosion, and (3) including an appropriate coarse material (admix) in the upper layer of the surface soil to form an armor layer.

11.6.3 Water Erosion

The potential hazard associated with water erosion is the same as that for wind erosion, namely the loss of soil from the top or surface layer.

Several of the following engineering approaches could be adopted to minimize the potential for water erosion:

- Limiting the surface slopes
- Providing run-on control with the sideslope drainage ditches
- Compacting the surface soil in a way that promotes significant infiltration rather than excessive run-off
- Properly designing the sideslopes to prevent gullying
- Establishing a vegetative cover to slow surface run-off
- Incorporating coarse material (pea gravel admix) in the upper portion of the surface soil layer to help form an erosion-resistant armor
- Limiting flow path lengths through the use of vegetation and admix.

The cover design would be evaluated for potential erosion damage from overall soil erodibility, sheet flow, and gullying.

11.6.4 Deep-Rooted Plants

The following design features could minimize the potential for problems with deep-rooted plants.

- The surface soil (top two layers) would retain most of the precipitation, because the underlying drainage layer would have significantly higher permeability and much less water retention capacity. Therefore, it is expected that vegetation preferentially would occupy the surface soil layer and not have an affinity for growing into the drier underlying layers.

- The thickness of the surface soils would be sized to promote the development of semiarid deep-rooted perennial grasses and to discourage the development of deep-rooting intrusive species.

11.7 SCHEDULE FOR CLOSURE [I-1f]

As stated previously, closure of the IDF will be a complex process. At the time of closure, this closure plan will be updated to reflect the current closure plan schedule per WAC 173-303-830, Appendix I. In addition, when a closure date is established, a revised closure plan and closure schedule will be submitted to Ecology that contains detailed information regarding specific activities and implementation timeframes.

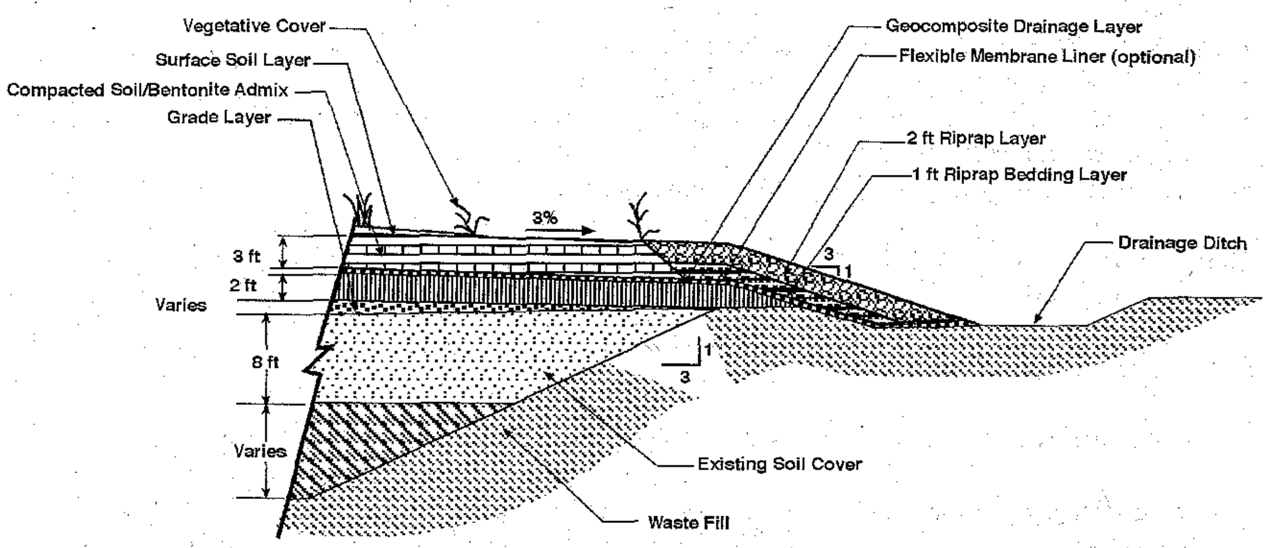
11.8 EXTENSION FOR CLOSURE [I-1(g)]

An extension for closure request is anticipated to complete the closure/postclosure process of the IDF.

11.9 POSTCLOSURE PLAN [I-3]

Because of the long active life of the IDF, a comprehensive postclosure plan will be developed when closure becomes imminent or when 200 Areas cleanup activities prescribed by the Tri-Party Agreement require integration.

Figure 11.1. Typical Hanford Site Landfill Cover Design



Notes:

1. Drawing not to scale.
2. Cover shown for unlined trench. Similar configuration for lined trench.

To convert feet (ft) to meters, multiply by 0.3048.

H00040105.2
M0105-2.1
5/31/01

13.0 OTHER FEDERAL AND STATE LAWS [J]

Generally, the laws applicable to the IDF include, but might not be limited to, the following:

- *Atomic Energy Act of 1954*
- *Federal Facility Compliance Act of 1992*
- *Clean Air Act of 1977*
- *Safe Drinking Water Act of 1974*
- *Emergency Planning and Community Right-to-Know Act of 1986*
- *Toxic Substances Control Act of 1976*
- *National Historic Preservation Act of 1966*
- *Endangered Species Act of 1973*
- *Fish and Wildlife Coordination Act of 1934*
- *Federal Insecticide, Fungicide, and Rodenticide Act of 1975*
- *Hazardous Materials Transportation Act of 1975*
- *National Environmental Policy Act of 1969*
- *Washington Clean Air Act of 1967*
- *Washington Water Pollution Control Act of 1945*
- *Washington Pesticide Control Act of 1971*
- *State Environmental Policy Act of 1971.*
- *Letter ,C.J .Paperiello NRC to J.E Kinzer DOE/RL "Classification of Hanford Low-Activity Tank Waste Fraction" dated June 9th 1997*

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Appendix 7A **Building Emergency Plan**